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Organizations having contractual relations with NASA may obtain *IAA* by writing NASA, Code ATSS-A, Washington, D.C. 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N.Y., 10017

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# Scientific and Technical Aerospace Reports

*A Semimonthly Publication of the National Aeronautics and Space Administration*

*March 23, 1964*

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Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

**N64-14178** National Aeronautics and Space Council, Washington, D.C.

**REPORT TO THE CONGRESS FROM THE PRESIDENT OF THE UNITED STATES: UNITED STATES AERONAUTICS AND SPACE ACTIVITIES, 1963**

[27 Jan. 1964] 145 p

This summary of the President's report includes the following: (1) The Mercury Program was completed with a perfect record. (2) The successful launch of Centaur, the first known flight of a high-energy rocket fueled with liquid hydrogen, was accomplished. Synchronous satellites Syncom I and II were orbited. (3) Twin satellites capable of detecting nuclear explosions in the atmosphere or in outer space were launched. (4) The X-15 research rocket-aircraft set new flight records on the fringes of space. Telstar II was orbited. (5) The first two spacecraft powered entirely by nuclear units were orbited. (6) Meteorological satellites Tiros VII and VIII were successfully launched. (7) Suborbital test flights were conducted of the ASSET winged reentry vehicle and of the Little Joe II Apollo boilerplate version of the vehicle to be used for the manned lunar mission. (8) The 120-inch solid rocket to be used with the Titan III was successfully tested. (9) The Hitchhiker scientific satellite was launched into orbit from another satellite that had been in orbit for several days. (10) The first stage of the Saturn booster, providing a thrust of 1,500,000 pounds, was successfully tested. (11) The U.S. placed about 60 satellite payloads into orbit. I.v.L.

**N64-14182** National Academy of Sciences-National Research Council, Washington, D.C.

**DIELECTRICS: DIGEST OF LITERATURE, VOLUME 26, 1962**

Daniel Berg (Westinghouse Elec. Corp.) and John C. Devins (GE) 1963 254 p refs

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**N64-14193** Westinghouse Electric Corp., Pittsburgh, Pa.

**APPLICATIONS [OF INSULATING MATERIALS AND DIELECTRICS TO ELECTRICAL MACHINERY AND DEVICES]**

H. M. Philofsky *In* Natl. Acad. of Sci.-Natl. Res. Council. Dielectrics. Dig. of Lit., vol. 26, 1962 1963 p 317–344 refs (See N64-14182 06-01)

An annotated bibliography is presented on: rotating machinery, transformers, cables and magnet wires, capacitors, switchgear, insulators, other applications, and evaluation of materials and insulating systems. R.T.K.

**N64-14204** Institute of Electrical and Electronics Engineers, New York, N.Y.

**REPORT ON THE THERMIONIC CONVERSION SPECIALIST CONFERENCE, OCTOBER 7-9, 1963 MOUNTAIN VIEW HOTEL, GATLINBURG, TENNESSEE**

[1963] 382 p refs Cosponsored by Am. Inst. of Aeron. and Astron.

Available from J. M. Houston, Gen. Elec. Res. Lab., P.O. Box 1088, Schenectady, N.Y., $15.00

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45. TEST RESULTS OF AN IN-PILE NUCLEAR THERMIONIC CONVERTER Eric S. Beckjord (Gen. Elec. Co.) p 332–340 refs

46. SERIES OPERATION OF THERMIONIC DIODES IN A NUCLEAR FUEL ELEMENT CONFIGURATION James D. Long (Martin Co.), Hugh L. Garvin (Hughes Res. Labs.), and Richard L. Hobbs (Martin Co.) p 341–344

47. ANALYSIS OF MULTICELL NETWORKS J. H. Broido, C. W. Savery, and William B. Wright (Gen. Dyn. Corp.) p 345–347

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50. DEVELOPMENT OF A LIGHTWEIGHT GASOLINE FUELED THERMIONIC ENGINE F. J. Lyczko and H. L. Traiger (Thermo Electron Eng. Corp.) p 362–371 refs

51. ASYMMETRICAL A.C. THERMIONICS W. R. Oppen (Ford Instr. Co.) p 372–375

**N64-14226** Hanford Atomic Products Operation, Richland, Wash.

**METALLURGY RESEARCH OPERATION. QUARTERLY PROGRESS REPORT, JULY, AUGUST, SEPTEMBER, 1963**

J. J. Cadwell, J. C. Tobin, T. K. Bierlein, R. L. Dillon, and R. G. Wheeler 15 Oct. 1963 258 p refs

(Contract AT(45-1)-1350)

(HW-78962) OTS: $3.50

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**N64-14337** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

**HEAT POWER ENGINEERING, SELECTED ARTICLES**

M. Ya. Polyanskiy et al 11 Oct. 1963 23 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 10, no. 2, 1963 p 19–26

(FTD-TT-63-963/1+2; AD-423835)

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1. REMOVAL OF SLUDGE FROM BOILER UNITS M. Ya. Polyanskiy and K. A. Blinov p 1–12 refs (See N64-14338 06-17)

2. VISUAL OBSERVATIONS OF INTRA-DRUM PROCESSES ON AN OPERATIONAL BOILER M. D. Panasenko, A. Ya. Antonov, V. N. Fomina, and Yu. V. Kozlov p 13–20 refs (See N64-14339 06-07)

**N64-14342** Joint Publications Research Service, Washington, D.C.

**SCIENCE OPENS ROADS TO THE FUTURE**

M. V. Keldysh 21 Nov. 1963 10 p Transl. into ENGLISH of an article from Pravda (Moscow), 7 Nov. 1963 p 6

(JPRS-21990; OTS-63-41205) OTS: $0.50

Soviet advancements in science and technology are discussed, including space flight, power engineering, magnetohydrodynamics, atomic energy, polymer chemistry, microbiology, and the social sciences. R.T.K

**N64-14432*** National Aeronautics and Space Administration, Washington, D.C.

**ADDRESS [NATIONAL SPACE PROGRAM] News Release**

James E. Webb 29 Jan. 1964 8 p Presented at St. Mary's Coll., Moraga, Calif., 29 Jan. 1964

NASA, in the last 28 months, has placed 26 satellites in orbit without a single launch-vehicle failure. Notable among

the various launch vehicles was the first launching of the Centaur rocket engine, which proved the feasibility of using liquid hydrogen as fuel for advanced space missions. These NASA satellites and deep-space probes have discovered such phenomena as the vast Van Allen radiation belts that surround the earth to a height of 40,000 miles or more. Beyond these radiation belts, an endlessly blowing solar wind and huge plasma clouds arising from the sun have been revealed, that periodically stir the solar wind into churning magnetic storms raging through interplanetary space. Mariner II has provided more knowledge about Venus than has been learned by all the astronomers in recorded history. By late this year, NASA expects to launch the first series of two-man Gemini flights into near-earth orbits. Also, work is progressing on the Apollo program, in which American explorers will be sent to the moon and back before this decade ends. I.v.L.

**N64-14458** International Council of Scientific Unions, Paris (France)

**GUIDE TO INTERNATIONAL DATA EXCHANGE (IQSY DISCIPLINES) [1960-ONWARDS] IQSY Instruction Manual No. 6**

W. L. Godson et al Sep. 1963 58 p refs

This guide to the International Years of the Quiet Sun describes the basic procedures for exchange of data through the World Data Centers (WDCs), and explains the procedures for collecting data in the WDCs for each discipline. The disciplines concerned are: meteorology, geomagnetism, aurora and airglow, the ionosphere, solar activity, and cosmic rays. I.v.L.

**N64-14531** Joint Publications Research Service, Washington, D.C.

**THE MEANING OF THE SPACE AGE, COMMENTS BY AUTHORITIES**

4 Feb. 1964 22 p Transl. into ENGLISH of 3 articles from Aviats. i Kosmonavt. (Moscow), no. 10, Oct. 1963 p 8–19 (JPRS-23062; OTS-64-21478) OTS: $0.75

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1. THE UNIVERSE HAS COME CLOSER A. Blagonravov p 1–6

2. LIFE BEYOND THE EARTH A. Oparin p 7–10

3. IN ORDER TO BECOME AN ASTRONAUT V. Parin et al p 11–19

**N64-14551** Sandia Corp., Albuquerque, N. Mex. Technical Information Dept.

**AEROSPACE NUCLEAR SAFETY, PROCEEDINGS [OF THE] TRINITY SECTION - AMERICAN NUCLEAR SOCIETY NATIONAL TOPICAL MEETING, ALBUQUERQUE, NEW MEXICO, OCTOBER 1-4, 1963**

R. E. Dunlap, ed. Jan. 1964 367 p refs

(Co-sponsored by AF, AEC, New Mex. U.)

(SC-DC-3553) OTS: $4.50

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2. SAFETY IN SCIENCE N. E. Bradbury (Los Alamos Sci. Lab.) p 19–21 (See N64-14553 06-01)

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3. TECHTOPIA OR TECHMANIA F. C. Di Luzio (Congr. Senate. Comm. on Aeron. and Space Sci.) p 25–32 (See N64-14554 06-01)

4. THE NASA AEROSPACE NUCLEAR SAFETY PHILOSOPHY H. B. Finger (NASA) p 33–37 (See N64-14555 06-30)

5. AEC AEROSPACE SAFETY PROGRAMS AND PHILOSOPHY F. K. Pittman (AEC) p 39–45 (See N64-14556 06-06)

6. USAF AEROSPACE NUCLEAR SAFETY PROGRAM AND PHILOSOPHY C. B. Stewart (Directorate of Nucl. Safety) p 46–53 ref (See N64-14557 06-01)

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7. DESIGN AND SAFETY ASPECTS OF HYDRIDE FUEL SNAP REACTORS D. J. Cockeram and R. L. Detterman (Atomics Intern.) p 55–63 (See N64-14558 06-06)

8. SNAP REACTOR TRANSIENT TESTS L. I. Moss (Atomics Intern.) and T. R. Wilson (Phillips Petrol. Co.) p 65–78 refs (See N64-14559 06-06)

9. AEROSPACE NUCLEAR SAFETY GROUND TEST PROGRAM J. L. Colp (Sandia Corp.) p 79–89 (See N64-14560 06-06)

10. SAFETY OF ISOTOPIC SNAP GENERATORS W. Hagis and D. G. Harvey (Martin Co.) p 91–102 refs (See N64-14561 06-06)

11. NUCLEAR SAFETY OF ADVANCED NUCLEAR SPACE POWER PLANTS: NONBOILING LITHIUM-COOLED REACTOR D. L. Cochran, J. P. Lehman, and G. H. Anno (Aerojet-Gen. Nucleonics) p 103–127 refs (See N64-14562 06-06)

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14. ROVER REACTOR TRANSIENT ANALYSES W. R. Stratton and C. G. Chezem (Los Alamos Sci. Lab.) p 155–165 refs (See N64-14565 06-23)

15. FLIGHT OPERATIONAL SAFETY SYSTEMS FOR NERVA R. I. Unger (Aerojet-Gen. Corp.) p 167–179 (See N64-14566 06-23)

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19. FALLOUT PREDICTION TECHNIQUES J. Z. Holland and A. W. Klement, Jr. (AEC) p 219–229 (See N64-14570 06-21)

20. ENVIRONMENTAL SAFETY ASPECTS OF ROCKET FLIGHT OPERATIONS M. I. Goldman and C. R. Mc Cullough (Nucl. Utility Serv., Inc.) p 231–240 refs (See N64-14571 06-30)

21. THE SPACE ENVIRONMENT AND ITS IMPLICATIONS FOR SPACECRAFT DESIGN J. B. Rittenhouse and F. J. Clauss (Lockheed Missiles and Space Co.) p 241–253 refs (See N64-14572 06-29)

22. SUPPLEMENTARY PAPER: OFF-SITE RADIOLOGICAL MONITORING PROCEDURES FOR MISSILE TEST RANGES M. W. Carter, R. D. Coleman, and D. J. Nelson, Jr. (Public Health Serv.) p 255–258 (See N64-14573 06-10)

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23. COMBUSTION AND DISINTEGRATION OF ZIRCONIUM HYDRIDE-URANIUM FUEL RODS F. E. Littman and A. E. Levy-Pascal (Astropower, Inc.) p 261–278 refs (See N64-14574 06-26)

24. AEROSPACE NUCLEAR SAFETY RE-ENTRY FLIGHT TEST PROGRAM A. J. Clark, Jr. (Sandia Corp.) p 279–293 (See N64-14575 06-30)

25. RE-ENTRY BURNUP ENHANCEMENT OF HYDRIDED ZIRCONIUM URANIUM ALLOY FUEL E. L. Foster, Jr. (Battelle Mem. Inst.) p 295–327 refs (See N64-14576 06-18)

26. RE-ENTRY OF FUELED GRAPHITE PARTICLES J. M. Bridges and H. G. Hargrove (Westinghouse Elec. Corp.) p 329–350 refs (See N64-14577 06-30)

27. SOURCE TERM PROGRAM–AN INTEGRATED TREATMENT OF RE-ENTRY PROBLEMS H. I. Kraig and J. M. Bridges (Westinghouse Elec. Corp.) p 351–360 (See N64-14578 06-23)

28. SPECIAL TOPIC: THE AIR FORCE NUCLEAR WEAPON SAFETY PROGRAM C. B. Stewart (Directorate of Nucl. Safety) p 361–366 (See N64-14579 06-01)

**N64-14552** Atomic Energy Commission, Washington, D.C.
**AEROSPACE NUCLEAR SAFETY–LESSONS FROM CIVILIAN AND MILITARY REACTOR EXPERIENCE**
James T. Ramey *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 9–16 (See N64-14551 06-01) OTS: $4.50

The ways in which safety is assured for civilian and military reactors are discussed, and the ways in which these procedures can be applied to the aerospace nuclear program are presented. The need for changes in the safety review process as experience is gained in the use of the nuclear system, the need for a highly competent technical reviewing staff, the need to establish overall standards for the safe design and operation of nuclear systems, and the need for experimental evidence to verify theoretical predictions regarding the safety of nuclear systems are among the problems considered. R.T.K.

**N64-14553** Los Alamos Scientific Lab., N. Mex.
**SAFETY IN SCIENCE**
N. E. Bradbury *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 19–21 (See N64-14551 06-01) OTS: $4.50

The historical fact that science and technology have traditionally brought new hazards and new safeties is discussed. R.T.K.

**N64-14554** Congress. Senate. Committee on Aeronautical and Space Sciences
**TECHTOPIA OR TECHMANIA**
F. C. Di Luzio *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 25–32 (See N64-14551 06-01) OTS: $4.50

The problems discussed are all related to the promise and problems of atomic energy in space, and in research and development in general. The problems are considered from a legislative point of view. R.T.K.

**N64-14557** Directorate of Nuclear Safety, Kirtland AFB, N. Mex.
**USAF AEROSPACE NUCLEAR SAFETY PROGRAM AND PHILOSOPHY**
C. B. Stewart *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 46–53 ref (See N64-14551 06-01) OTS: $4.50

National policy requires U.S. military forces to be in a state of advanced readiness throughout the world at all times. The use of nuclear energy for propulsion and auxiliary power is rapidly becoming more than a scientific theory. Both of these facts mean that a major effort is required to ensure that the safety of operating personnel and the general public is adequate. A description is given of the Air Force approach to this problem. R.T.K.

**N64-14579** Directorate of Nuclear Safety, Kirtland AFB, N. Mex.
**THE AIR FORCE NUCLEAR WEAPON SAFETY PROGRAM**
C. B. Stewart *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 361–366 (See N64-14551 06-01) OTS: $4.50

The major parts of the program of nuclear weapon accident prevention are described. Included is a discussion of: (1) the programs for technical and operational safety analysis of nuclear weapon systems, and (2) the ways in which an effective and aggressive nuclear safety program is assured at all levels of command. R.T.K.

**N64-14747** European Atomic Energy Community, Brussels (Belgium)
**PRELIMINARY STUDY OF THE ECONOMIC EFFECTS OF INCORPORATING NUCLEAR POWER PLANTS IN A GRID [STUDIO PRELIMINARE DEGLI EFFETTI ECONOMICI DELL 'INSERIMENTO IN RETE DI CENTRALI NUCLEARI DI POTENZA]**
Nov. 1963 160 p In ITALIAN; ENGLISH abstract Report of work performed under contract by Comitato Nazionale per l' Energia Nucleare
(Contract EURATOM-014-62-11 ECII)
(EUR-468.i) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 210 Belg. Fr.

The work covered by this report is intended to contribute to solving the economic problems associated with operating electric grids in which nuclear powerplants are incorporated. The report gives the results obtained by simulating the coordinated economic operation of a combined hydroelectric and thermoelectric grid and describes the part that nuclear powerplants can play in such a grid. Author

**N64-14896*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**SPACE PROGRAMS SUMMARY NO. 37-24, VOLUME IV FOR THE PERIOD OCTOBER 1, 1963 TO NOVEMBER 30, 1963. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT**
31 Dec. 1963 289 p refs
(NASA Contract NAS7-100)
(NASA CR-53054; JPL-SPS-37-24, Vol. 4) OTS: $18.00 ph, $8.87 mf

A digest is given of material concerning the lunar program, the planetary–interplanetary program, the deep-space instrumentation facility, and supporting research and advanced development. Included are: systems analyses, guidance and control studies, engineering mechanics, engineering facilities, propulsion, telecommunications, and space sciences. C.L.W.

# 02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

**N64-14259** United Aircraft Corp., East Hartford, Conn. Research Labs.
**APPLICATION OF THE METHOD OF CHARACTERISTICS INCLUDING REACTION KINETICS TO NOZZLE FLOW**
J. R. Keilbach, T. F. Zupnik, E. N. Nilson (Pratt and Whitney Aircraft), F. Landis (New York U. , and D. Ables (Systems Develop. Corp.) N.Y., Am. Inst. of Aeron. and Astronautics [1964] 11 p refs Presented at the AIAA Aerospace Sci. Meeting, New York, 20–22 Jan. 1964
(AIAA Paper 64–97) AIAA: $0.50 members, $1.00 nonmembers

Improved techniques for exhaust-nozzle performance estimation are presented. These techniques incorporate the reaction kinetics in the method of characteristics construction for two-dimensional and axisymmetric nozzles. The general numerical procedures are shown including the handling of a variety of fundamental difficulties arising in the numerical implementation. The analysis is restricted to thermally perfect gases where vibrational equilibrium is maintained throughout. Problems associated with obtaining an assessment of the extent to which finite reaction rates affect the flow field within a nozzle of predetermined geometry and with the generation of a wall contour for employment in the design of an exhaust nozzle are discussed. The basic flow equations and the characteristics construction are discussed, and the results of the computation procedures are presented for $H_2$-$O_2$ propellant nozzles to illustrate the effect of incorporating reactions kinetics. A comparison of analytical and experimental results is presented for the specific case of $N_2O_4 \rightleftharpoons NO_2$. I.v.L.

**N64-14326** RAND Corp., Santa Monica, Calif.
**A THIN AIRFOIL WITH A MINIMUM AVERAGE COEFFICIENT OF HEAT TRANSFER FOR A GIVEN LIFT [TONKII PROFIL' KRYLAS MINIMAL'NYM POD'EMNOI SILE]**
E. V. Bulygina, M. B. Poliakov, and Is. S. Shcherbak Nov. 1962 18 p refs Transl. into ENGLISH from Izv. Vysshikh Ucheb. Zavedenii. Aviats. Tekh. (USSR), v. 2, 1961 p 17–25
(Contract AF 49(638)-700)
(RM-3410-PR; AD-291718)

The problem considered is the determination of an airfoil shape that, at a given lift coefficient, provides for a minimum average heat-transfer coefficient of the profile. The problem is solved by using the following simplifying assumptions: (1) A thin profile is assumed (the angles of inclination of its upper and lower surfaces are the same). (2) The lower and upper surfaces of the profile are heat insulated. (3) The boundary layer is either completely laminar or completely turbulent. The value of the heat-transfer coefficient was found to depend essentially on the temperature factor. R.T.K.

**N64-14343** Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
**GENERAL LAMINAR FLOWS PAST LEADING AND TRAILING EDGES OF A SEMI-INFINITE PLATE**
Hans J. Lugt and Ernst W. Schwiderski Oct. 1963 44 p refs
(NWL-1887; AD-428029) OTS: $4.60

The characteristics of general laminar flows around the edge of a semi-infinite flat plate are investigated on the basis of the complete Navier–Stokes equations. The solution of this singular and nonlinear problem is obtained in an exact and linear manner in the form of a double series around the edge. It permits a rigorous discussion of the properties of flows around an edge, which are of importance in the practical applications and in the theory of viscous and nonviscous fluid motions. In particular, it becomes possible to check the reliability of the Kutta condition, which represents a fundamental proposition in ideal flow theory. Author

**N64-14364** Minnesota U., Minneapolis
**PRESSURE DISTRIBUTION IN THE WAKE OF TWO BODIES OF REVOLUTION AT TRANSONIC AND SUPERSONIC SPEEDS**
Helmut G. Heinrich and R. Sheldon Hess Wright-Patterson AFB, Ohio. Directorate of Aeromechanics, Dec. 1963 57 p refs
(Contract AF 33(616)-6372; Contract AF 33(616)-8310)
(ASD-TDR-62-1104; AD-427748)

At transonic free-stream velocities the characteristics of the wake near the body are somewhat similar to those of the wake in the subsonic flow regime. It appears that the theoretical approaches that were satisfactory in the subsonic flow regime could be modified and may become useful for the prediction of flow characteristics in transonic flow. At free-stream supersonic Mach numbers the wake in the near-body region suffers considerable interferences from flow expansion, trailing shock, and variation of density. The intensity of these interferences differs with the form of the forebody. An analytical method to predict the velocity and pressure distribution in the near-body region in supersonic flow has not been devised at this time. Author

**N64-14376** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**ABOUT TRANSITION OF A LAMINAR BOUNDARY LAYER INTO A TURBULENT ONE AT JET FLOWING AROUND OF A PLATE**
L. A. Vulis, Z. B. Sakipov, and A. T. Trofimenko 26 Sep. 1963 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), No. 3, 1962 p 53–60
(FTD-MT-63-84/1+2+3+4; AD-428552) OTS: $1.60

A discussion is presented of results of an experimental investigation of the flow of a flat stream of water or air along a plate. Flat, semilimited turbulent streams are considered. R.T.K.

**N64-14688** Minnesota U., Minneapolis
**VELOCITY DISTRIBUTION IN THE WAKE OF BODIES OF REVOLUTION BASED ON DRAG COEFFICIENT**
Helmut G. Heinrich and Donald J. Eckstrom Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Dec. 1963 72 p refs
(Contract AF 33(616)-8310)
(ASD-TDR-62-1103; AD-427736)

A theoretical analysis of the turbulent wake behind a body of revolution has been made, and an equation for the velocity distribution in the wake has been found in terms of 4 constants that are determined from experiments. Measurements of the velocity distribution in the wake behind 12 bodies of revolution are presented, and the 4 constants for each body are derived. A generalization of the empirical constants in terms of body drag coefficient is made. Calculation velocity distributions using the empirical constants compare satisfactorily with measured distributions. Author

N64-14726* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**INVESTIGATION OF THE IMPACT OF COPPER FILAMENTS INTO ALUMINUM TARGETS AT VELOCITIES TO 16,000 FEET PER SECOND**
C. Robert Nysmith, James L. Summers, and B. Pat Denardo Washington, NASA, Feb. 1964 12 p refs
(NASA TN D-1981) OTS: $0.50

One-half-inch-diameter aluminum spheres were fired into thin copper filaments (0.0025-in. diam. and 0.75-in. length) at velocities to 16,000 fps, then recovered and sectioned to determine the damage. The principal variable was the filament angle of inclination. Microscopic examination of the sectioned targets and photographs revealed the various crater characteristics and penetration parameters for each shot. As the angle of inclination increased from 0° to 7°, the depth of penetration decreased by a factor greater than 3 with most of the decrease occurring in the range from 4° to 5°. Above 10° inclination angle, the penetration decreased more gradually to a final depth at broadside impact of approximately 1/10 that for end-on impact. The characteristic features of the craters also changed in these inclination ranges. Limited tests with filaments of 0.0015-in. diameter showed a decrease in penetration approximately in proportion to the decrease in diameter. Author

N64-14891* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**WIND-TUNNEL TEST OF THE SPACE-GENERAL CORPORATION ASTROBEE-1500 MODEL**
Charles E. Searls, Jr. 16 Oct. 1963 124 p refs
(NASA CR-53042; JPL-WT 20-519) OTS: $10.10 ph, $3.92 mf

A wind-tunnel test of the Astrobee-1500 model was conducted. The purpose of the test was to determine the six-component forces and moments of the Astrobee-1500 model. The approximate aerodynamic parameters for the test were Mach numbers 1.81, 2.41, 3.50, and 4.54; dynamic pressures from 3.0 to 10.2 psi; and Reynolds No./in. from $0.32 \times 10^6$ to $0.57 \times 10^6$. The test variables and ranges were angles-of-attack from −2 to 10 deg and angles of roll from 0 to 90 deg, for each of two configurations. Each model configuration consisted of a two-part conical nose, a cylindrical body, four equally spaced tail fins, and two auxiliary booster rockets at the base. Forces and moment were obtained for the complete configuration on a six-component, internal, strain-gage balance. R.T.K.

N64-14899* General Dynamics/Astronautics, San Diego, Calif.
**STUDY OF PRINCIPLES OF METEOROID PROTECTION Progress Report No. 3, 2 Oct.-29 Dec. 1961**
R. F. Rolsten, H. H. Hunt, and J. N. Wellnitz Jan. 1962 67 p
(NASA Contract NAS8-875)
(NASA CR-55371; AE62-0092) OTS: $6.60 ph, $2.21 mf

Progress can be summarized as follows: (1) Additional impact data were obtained with the 0.090- and 0.063-in. aluminum (6061-T6) bumpers. (2) Impact data were obtained with 0.125- and 0.032-in. aluminum (6061-T6) bumpers. (3) Bumpers of plate glass and wire screen were tested. (4) The 0.57-g projectile was accelerated, with slight premature fragmentation, to a velocity of 26,800 fps. (5) Projectile mass was lowered to 0.097-g. (6) Copper and glass projectiles were accelerated to high velocity (12,000 fps). (7) The evaluation of energy absorbers was started. (8) Structures pressurized with water and gaseous oxygen were tested. (9) High-speed photographic coverage of the impact phenomena was obtained. (10) The principles of meteoroid protection were elaborated further. Author

N64-14974 Aro, Inc., Arnold Air Force Station, Tenn.
**COMPARISON OF HOTSHOT TUNNEL FORCE, PRESSURE, HEAT-TRANSFER AND SHOCK SHAPE DATA WITH SHOCK TUNNEL DATA**
E. E. Edenfield Arnold Eng. Develop. Center, Jan. 1964 33 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-1; AD-428916)

Several cone models of varying bluntness were tested through an angle-of-attack range of 0° to 40°. Excellent agreement of the hotshot and the shock tunnel data is shown. Author

# 03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-14236 College of Aeronautics, Cranfield (Gt. Brit.)
**THE IN-FLIGHT CALIBRATION OF SIDESLIP VANES USING THE "FLAT TURN" TECHNIQUE**
W. G. Bradley [1963] 17 p refs
(CoA-Aero-168)

The "flat turn" technique for the calibration of sideslip vanes is described. Details are given of the in-flight calibrations of sideslip vanes mounted on a de Havilland DOVE Mk 5 aircraft, and a Morane-Saulnier M.S. 760 PARIS I aircraft. Author

N64-14767 Minnesota U., Minneapolis St. Anthony Falls Hydraulic Lab.
**FORCE CHARACTERISTICS OF FLAPPED VENTILATED HYDROFOILS IN SMOOTH AND ROUGH WATER Project Report No. 66 [1 Nov. 1961-31 Jan. 1963]**
J. M. Wetzel and W. H. C. Maxwell Jan. 1963 80 p refs
(Contract Nonr-710(47))
(AD-425454)

Experimental measurements were made of the lift and drag forces on superventilated hydrofoils of finite span submerged below a free surface. The foils were equipped with fixed trailing-edge flaps of various angles of deflection. Experimental lift data taken with the foil in smooth water and extrapolated to zero cavitation number agreed well with two-dimensional theory modified to include effects of finite span and submergence. Measurements of the oscillatory forces for an artificially ventilated foil moving through a regular progressive wave train agreed well with quasi-steady calculations for near zero $\sigma$. At the higher $\sigma$, the calculated values were greater than the measured, primarily through deficiencies in the prediction of the oscillatory cavity pressure. Author

# 04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

**N64-14255** Joint Publications Research Service, Washington, D.C.
**GUIDED MISSILES**
V. I. Marisov and I. K. Kucherov 31 Jan. 1964 335 p refs Transl. into ENGLISH of the book "Upravlyayemyye Snaryady" Moscow, Min. of Defense Press USSR, 1959 p 1-303
(JPRS-23032; OTS-64-21461) OTS: $5.00

This book presents a brief exposition of the fundamental problems associated with the latest branch of military engineering—guided missiles. Included are data on the military capabilities of the modern types of guided missiles, possible methods of military application, and principles of operation and arrangement of the component parts of the guided missile such as the guidance system, the engines, and the aerodynamic components. Author

**N64-14378** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EQUATION OF MOTION OF AN AIRCRAFT WITH A JET ENGINE**
G. M. Trakhtenberg 7 Oct. 1963 35 p refs Transl. into ENGLISH from Izv. Vysshikh Ucheb. Zavedenic Aviats. Tekh. (USSR), no. 4, 1962 p 36-56
(FTD-MT-63-94/1+2; AD-428550) OTS: $3.60

The calculation of the dynamics of fuel-mixture overflowing in an aircraft with a liquid-fuel rocket engine and of the variability of aircraft mass on the motion of the aircraft as a whole is discussed. A model is considered in which the mass of the aircraft is gradually decreasing. This mass consists of "solid elements" having relative velocities and acceleration in a combined system of coordinates. The "solid elements" are the fuel-mixture particles, and two examples are considered—the liquid fuel from the nose tank overflows into the tail tank, and the liquid fuel continuously overflows from the nose tank into the tail tank and then flows from the aircraft with a determined speed. A thrust equal to the reactive force determined experimentally on the testing stand is applied to the aircraft. Based on the above considerations, the equations of motion of an aircraft of variable mass are derived. These equations are extended to the case of a turbojet engine and cover the motion of the aircraft in the most general form. However, when determining the derivatives of the moments of inertia and the coordinates of the center of gravity in the equations of motion, the separated and joined masses of the jet aircraft should be considered. I.v.L.

**N64-14407*** National Aeronautics and Space Administration, Washington, D.C.
**X-15; RESEARCH AT THE EDGE OF SPACE**
Washington, Govt. Print. Off. [1963] 36 p
(NASA EP-9) GPO: $0.30

The primary mission of the X-15 was the acquisition of new information concerning the broad range of flight conditions in hitherto unexplored flight regimes. One important contribution of the X-15 program resulted from the investigation of aerodynamic heating. The X-15 also has produced important information concerning the glass needed for the windshield and passenger windows in high-speed aircraft. Data have been gathered on the effect of high noise levels on aircraft materials. Information is included on earlier research aircraft, concept, history and technical considerations, and the present and future X-15 flight program. R.T.K.

**N64-14414** Advisory Group for Aeronautical Research and Development, Paris (France)
**SOME STRUCTURAL AND AERODYNAMIC CONSIDERATIONS OF VARIABLE SWEEP**
A. N. Clifton (Vickers-Armstrongs Aircraft, Ltd.) Apr. 1963 17 p FRENCH summary
(AGARD-438)

This report discusses a number of important considerations in connection with variable-sweep airplanes, particularly the question of where the pivot should be located. In addition to the main advantages to be gained from matching sweep angle to speed, it also offers some less obvious possibilities of adjusting trim drag and stability, and a new method of lateral control at high sweep angles. Author

**N64-14485** Chance Vought Corp., Dallas, Tex.
**A RATIONAL METHOD FOR PREDICTING ALIGHTING GEAR DYNAMIC LOADS. VOLUME I, GENERAL METHODS Technical Report, 2 Feb. 1961-30 Jun. 1962**
T. R. Ferguson, J. Mollick, and W. W. Kitts Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Dec. 1963 187 p refs
(Contract AF 33(616)-7824)
(ASD-TDR-62-555, Vol. 1; AD-428027)

Equations describing the motions of a vehicle during landing impact are developed for an arbitrary vehicle configuration. The method is sufficiently general and accurate to allow the formulation of alighting gear dynamics problems in flight vehicles including V/STOL aircraft, high gross weight logistic vehicles, recoverable booster vehicles, advanced tactical and defense vehicles operating out of remote areas, and lunar vehicles. It allows for the effects of varying coefficients of friction and damping, combinations of initial conditions of pitch, roll, yaw angles and rates, vertical, longitudinal, and lateral motion, slippage of the gear relative to the alighting surface, flexible alighting gear and vehicle structure, simultaneously applied triaxial ground loads, and alighting elements. The formulation is intended for the cantilevered type of gear, although the articulated type may be handled through some extensions of the formulation. A survey of the various types of forces which occur during landing impact is made, and the manner in which these forces enter the equations of motion is described.
Author

**N64-14486** Chance Vought Corp., Dallas, Tex.
**A RATIONAL METHOD FOR PREDICTING ALIGHTING GEAR DYNAMIC LOADS. VOLUME II, EXAMPLES Technical Report, 2 Feb. 1961-30 Jun. 1962**
T. R. Ferguson, J. Mollick, and W. W. Kitts Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Dec. 1963 140 p
(Contract AF 33(616)-7824)
(ASD-TDR-62-555, Vol. 2; AD-428181)

Several illustrative examples, with accompanying numerical solutions, are provided as a didactic means of illustrating how the General Method, Volume I, is applied to various landing impact problems. Symmetrical landing of a conventional aircraft, asymmetrical landing of an advanced vehicle, spike penetration landing, and cantilevered, articulated, and semiarticulated gears are considered. Author

**N64-14500** Bendix Corp., York, Pa.
**PORTABLE AIRCRAFT CONDITION EVALUATOR RECORDER: PROJECT PACER Final Report**
Ft. Eustis, Va., Army Transportation Res. Command, Dec. 1963 80 p
(Contract DA-44-177-TC-750)
(TRECOM-TR-63-48; AD-427770)

This paper describes a program to study and design an automatic electronic checkout system to evaluate and record aircraft component condition for Army aircraft. The system will provide a printed and punched tape record. Selected test

areas of the aircraft are monitored during static and dynamic conditions. The system sensors are integral with the aircraft, whereas the evaluation and recording portion is ground support equipment. This system is compatible with the ALARM system. Author

**N64-14614** Technische Hochschule Stuttgart (W. Germany)
**OPTIMIZATION OF A FLIGHT COURSE ADJUSTMENT WITH BLACK-WHITE VANE UNDER THE INFLUENCE OF TIME-DEPENDENT DISTURBANCES [OPTIMIERUNG EINER FLUGKURSREGELUNG MIT SCHWARZ-WEISS-STELLGLIED UNTER DEM EINFLUß ZEITABHANGIGER STORUNGEN]**
Wolfgang Trautwein [1963] 30 p refs In GERMAN Presented at the WGLR Ann. Meeting, Munich, Oct. 1963

The yawing motion in yaw, of a flying body can be described approximately by the equation $\ddot{\psi} + 2D\omega\dot{\psi} + \omega^2\psi = -N_\zeta\zeta + N_S$, where D is the Lehr attenuation magnitude, $N_\zeta\zeta$ and $N_S$ are the control and interference moments relative to the moment of inertia and $\omega$ is the natural frequency. In the control system studied, the maximum principle of Pontryagin's shortest buildup of transient oscillations was adhered to when the rudder operated as a black–white vane. The difficulties of applying theory to practical cases are discussed. By reformulating the control problem, it was possible to use Chestnut's method of predictive control. A modification was instigated by which this method became generally valid and permitted the relatively simple construction of a flight control. A test of the optimized course control on digital and analog computers gave favorable results. However, the control system is sensitive to a parametric change; thus a good adjustment of the flight control to a change in flight conditions is necessary for its practical application. Also, the optimization of control circuits, with markedly limited speed, was obtained for a special class of interferences. Trans. by I.v.L.

**N64-14615** Chance Vought Corp., Dallas, Tex. Aeronautics and Missiles Div.
**XC-142A VTOL TRANSPORT PROGRAM Semi-Annual Report No. 3, Jan.-Jun. 1963**
L.C. Josephs [1963] 25 p refs
(Contract AF 33(657)-7868)
(AD-428617) OTS: $2.60

Progress reported includes the completion of the 0.110-scale-model wind-tunnel tests and the control system bearing-wear tests. Tooling and structural-design achievements are also cited. J.E.T.

**N64-14728*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**LARGE-SCALE WIND-TUNNEL TESTS OF AN AIRPLANE MODEL WITH AN UNSWEPT TILT WING OF ASPECT RATIO 5.5, AND WITH VARIOUS STALL CONTROL DEVICES**
James A. Weiberg and Demo J. Giulianetti Washington, NASA, Feb. 1964 44 p refs
(NASA TN D-2133) OTS: $1.25

Results are presented of the effects of slats, flaps, wing-fuselage ramp fairing, and propeller rotation on the flow separation, buffet, and descent characteristics of a tilt-wing deflected-slipstream VTOL model. The results indicated that wing stall and resulting buffet in descending flight could be delayed approximately 15 knots by a slat, BLC nose flap, or increased trailing-edge flap effectiveness. Author

**N64-14729*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**AERODYNAMIC DATA ON A LARGE SEMISPAN TILTING WING WITH 0.6-DIAMETER CHORD, FOWLER FLAP, AND SINGLE PROPELLER ROTATING UP AT TIP**
Marvin P. Fink, Robert G. Mitchell, and Lucy C. White Washington, NASA, Feb. 1964 156 p
(NASA TN D-2180) OTS: $3.00

The wing had a chord of 0.6 propeller diameter, a Fowler flap, an aspect ratio of 4.05 (2.025 for the semispan), a taper ratio of 1.0, and an NACA 4415 airfoil section. Tuft tests showed no stall on the part of the wing immersed in the propeller slipstream at angles of attack well above that corresponding to the peak of the lift curve for the high-thrust conditions that occur in the STOL range of flight. The wing–flap combination was found to be sufficiently effective to prevent wing stall except in the unprotected center section (judged from tuft-test results) over the entire range of STOL operating conditions covered in the tests, which included the conditions required for descent angles as high as about 20° for each test. The use of leading-edge high-lift or stall-control devices was not found to be beneficial in the conditions corresponding to the STOL flight range, because the wing did not stall without such devices. Author

**N64-14758*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**ENTRY VEHICLES**
John V. Becker Repr. from Astronautics and Aerospace Eng., Nov. 1963 p 70–74
(NASA RP-118)

In the development of entry vehicle designs, a great amount of research is centered on the choice of hypersonic maneuverability, or lift–drag ratio. Different configurations are discussed in an attempt to select the design having the most desirable lift–drag characteristics. The first lifting body to be investigated extensively is based on the round-bottomed half-cone shape, with the aim of deriving some advantage from available cone theory. The modified flat-bottomed half-cone vehicle and other thickened delta wing designs with various degrees of nose blunting, thickness, and camber distributions have also appeared. It is made clear that landable entry vehicles comprise a complex synthesis of advanced research data from many disciplines, blended together with many assumptions and compromises representing the arbitrary preferences of the designer. C.L.W.

**N64-14768** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**THE DESIGN OF AIRCRAFT**
N. A. Fomin 12 Dec. 1963 453 p refs Transl. into ENGLISH of the book "Proyektirovaniye Samoletov", Moscow, Gos. Nauchno-Tekhn. Izd., 1961 p 1–362
(FTD-TT-62-913/1+2; AD-426975)

Mathematical expressions linking the basic parameters of the aircraft with its flight characteristics are derived. An aircraft design procedure is used that permits determination of optimum solutions for problems. The first part of the book is devoted to methods of determining the weight and basic parameters of the aircraft as a whole, its general layout, and the selection of its aerodynamic design. The second part is devoted to methods of determining the weight and parameters of parts of the aircraft and selection of the airframe layouts. R.T.K.

**N64-14797** Douglas Aircraft Co., Inc., Long Beach, Calif.
**TRAILING VORTICES OF JET TRANSPORT AIRCRAFT DURING TAKEOFF AND LANDING Final Report**
E. L. Zwieback Jan. 1964 60 p refs
(Contract FA-WA-4306)
(RD-64-3)

The effect of ground plane and ambient winds on movement and strength decay was investigated. The results are compared with a modified potential flow theory. The position of the trailing vortices near the ground is extremely sensitive to low level ambient winds and vertical gradients of the wind. The measured positions of the trailing vortices indicate probable correlation with the potential flow theory, with noted exceptions to the assumptions used. Measured vortex velocity decay rates are comparable to a modified theoretical free vortex viscous decay. Distinct vortex velocity fields were observed near the ground, using a smoke generator technique, for periods up to 65 seconds after aircraft passage. No differences in the trailing vortex system of two rolled-up vortices were observed for both the takeoff and landing configurations of the DC-8 aircraft. Author

**N64-14970** Kaman Aircraft Corp., Bloomfield, Calif.
**INVESTIGATION OF STORED ENERGY ROTORS FOR RECOVERY**
D. W. Robinson, Jr. et al Wright-Patterson AFB, Ohio, Flight Dyn. Lab., Dec. 1963 283 p refs
(Contract AF 33(616)-7544; supplemental agreements 1-6)
(R-467; ASD-TDR-63-745; AD-428998)

Analytical studies on the performance, stability, and control characteristics of rotary-wing decelerators in axial descent, controlled glide flight, and flared landings were performed to investigate the potential capabilities of stored-energy rotor systems for the retardation and controlled recovery of payloads. Rotor parameters, such as diameter, solidity, disc loading, mass, etc., were considered. Theoretical predictions are compared with experimental test results. Wind-tunnel tests simulating typical reentry trajectory altitude and dynamic conditions were performed on a rotary-wing decelerator system, similar in configuration and construction to the free-flight test rotor system, at speeds from Mach 0.5 to 3.0 to demonstrate feasibility of deploying and operating such systems at supersonic speeds in axial flow and to determine the rotor and governor characteristics for such an operation. Author

**N64-14978** Ryan Aeronautical Co., San Diego, Calif.
**FLEXIBLE-WING PRECISION DROP GLIDER Final Report**
Ft. Eustis, Va., Army Transportation Res. Command, Dec. 15, 1963 150 p refs
(Contract DA-44-177-AMC-875(T))
(Rept. 63B011; TRECOM-TR-63-64; AD-426250)

The result of an experimental development and test program of an inflatable flexible-wing precision drop glider is presented. System operation and wing packing procedures are discussed. Aerodynamics, loads, design, stress, weights, and test data such as glide performance, turning radius, rate of turn, and impact accuracy are given. Author

**N64-14982*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**THE DESIGN OF SAILPLANES FOR OPTIMUM THERMAL SOARING PERFORMANCE**
Clarence D. Cone, Jr. Washington, NASA, Jan. 1964 50 p refs
(NASA TN D-2052) OTS: $1.25

The meteorological aspects of isolated buoyant convections (thermals) are discussed in relation to efficient soaring plane design, and the fundamental performance equation for soaring in such convections is derived. A design procedure for determining the optimum solution of the performance equation under specified thermal conditions is presented. The procedure integrates the simultaneous effects of meteorological, aerodynamic, and structural factors on soaring performance. The design procedure is illustrated in the calculation and analysis of the design charts for a conventional-geometry sailplane intended for efficient thermal soaring. Various aspects of designing for adequate gliding qualities are also discussed. Author

# 05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see:* 12 Geophysics, and 29 Space Sciences.

**N64-14179*** Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research
**ON A POSSIBLE CLASS OF GALACTIC RADIO SOURCES**
D. W. Sciama 26 Aug. 1963 29 p refs Submitted for Publication
(NASA Grant NsG-382)
(NASA CR-55340; CRSR-152) OTS: $2.60 ph, $1.07 mf

In a previous paper it was shown that the steady state theory of the universe can be reconciled with the Cambridge counts of radio sources if a substantial fraction of the sources lie within the galaxy and have a certain set of properties. In this paper, an astrophysical mechanism is described which might give rise to such a distribution of galactic sources. The mechanism consists of the rotational instability of gravitationally contracting low-mass stars, and the consequent conversion of rotational energy into magnetic and relativistic particle energy. Author

**N64-14269*** California U., San Diego
**SHOCK EMPLACED ARGON IN A STONY METEORITE. PART 1: SHOCK EXPERIMENT AND PETROLOGY OF SAMPLE. PART 2: A COMPARISON WITH NATURAL ARGON IN ITS DIFFUSION**
Kurt Fredriksson, Paul De Carli (Stanford Res. Inst.), R. O. Pepin, J. H. Reynolds, and G. Turner 1963 21 p refs Submitted for Publication
(NASA Grant NsG-317-63)
(NASA CR-55365) OTS: $2.60 ph, $0.83 mf

A sample of the Bjurböle chondrite was exposed to artificial shock in an argon atmosphere. The sample consisted of grayish-white powdery material with chondrules. This shock changed the material to fine-grained black and well-indurated rock, similar to a black chondrite. Subsequent analysis showed that the shocked sample had incorporated considerable amounts of argon, most of which was retained even at high temperatures and was not released until the material was melted. These results support earlier suggestions that the irregular distribution of rare gases, as well as the light–dark structures in such meteorites as Pantar and Kapoeta, could have been caused by shock waves. Author

**N64-14359** New Mexico State U., University Park
**PLANETARY AND LUNAR RESEARCH IN THE PHOTOGRAPHIC INFRARED, VISIBLE AND ULTRAVIOLET Semi-Annual Report No. 5, 1 Apr.-30 Sep. 1963**
Clyde W. Tombaugh Oct. 1963 5 p
(Grant DA-ARO(D)-31-124-G41) OTS: $1.10
(AD-428392)

Activities dealing with the observation of Venus, Mars, Jupiter, and Saturn are discussed. P.V.E.

**N64-14391*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**ESTIMATION OF TOLERANCE LIMITS FOR METEOROID HAZARD TO SPACE VEHICLES 100-500 KILOMETERS ABOVE THE SURFACE OF THE EARTH**
Charles C. Dalton Washington, NASA, Feb. 1964 58 p refs
(NASA TN D-1996) OTS: $ .50

Quartile estimates are established for mean flux, puncturable thickness of aluminum and steel walls as functions of meteoroid mass, puncture flux as functions of the thickness of walls, and thickness of walls necessary for reliability and operational design objectives. Author

**N64-14424** North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
**STAR PATTERN RECOGNITION, A SURVEY OF THE LITERATURE [1958-1963]**
H. W. Sowers 25 Oct. 1963 34 p refs
(SID-63-710)

Literature on star-pattern recognition, devices, and related topics since 1958 is surveyed. References to reports and periodical literature of English and foreign origin are included; foreign references deal only with related topics. All known star-pattern recognition concepts, of an unclassified nature, have been included. Author

**N64-14439** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**CERTAIN GENERAL METHODS FOR QUALITATIVE ANALYSIS OF THE FORMS OF MOTION IN PROBLEMS OF CELESTIAL MECHANICS. PART I: THE METHOD OF CONTACT CHARACTERISTICS IN THE CASE OF TWO DEGREES OF FREEDOM**
N. Moiseev Jan. 1962 202 p refs Transl. into ENGLISH from Tr. Gos. Astron. Inst. Im. P.K. Shternberga (Moscow), v. 3, no. 1, 1936 p 5-125
(MH Transl. 357)

The purpose of this work is the presentation of the theoretical bases of certain general methods for the qualitative analysis of trajectory properties in problems of classical and nonclassical celestial mechanics. This includes: (1) the basic methods for the general qualitative analysis of the properties of motion in dynamic problems, without requiring numerical integration of the equations of motion to any great extent, and (2) the establishment of the interrelations with other methods of qualitative analysis. Author

**N64-14440** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**ESTIMATING PERTURBATIONS OF HYPERBOLIC MOTION IN THE THREE-BODY PROBLEM**
V. M. Alekseev [1960] 26 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 36, no. 6 p 1099-1113
(MH Transl. 363)

The motion of three mass points, interacting in the Newtonian gravitational sense, is examined. Using general theorems developed previously, specific estimates are obtained on the perturbation of the relative motion of two of the mass points under the following two restrictions: (1) the osculating motion is hyperbolic, and (2) the distance between the pair, at the initial instant, is either minimal or has a positive time derivative. These techniques are applicable to the study of an entire class of trajectories. Author

**N64-14515** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena Space Sci. Div.
**THE ANOMALOUS INCLINATION OF THE JOVIAN AMMONIA LINES**
Hyron Spinrad Repr. from the Astrophys. J., v. 136, no. 1 Jul. 1962 p 311 refs

The $NH_3$ lines in the $\lambda$ 6460 band are well resolved on four Mount Wilson and Palomar coudé spectrograms of Jupiter. Two of these (Ce 817 by Dunham in 1934 and Pa 6055 by Münch in 1961) were taken with the slit along the Jovian equator. These plates clearly show the Fraunhofer lines tilted with respect to the comparison lines and the nearby $H_2O$ lines. However, the inclination of the ammonia lines is strikingly different from the reflected solar lines; the inclination of the $NH_3$ lines was about 22 percent of the Fraunhofer line inclination on Ce 817 and about 30 percent on Pa 6055. The errors of measurements are about 5 percent—far too small to permit the expected result of 50 percent of the solar-line inclination. A satisfactory explanation for the anomalous ammonia-line tilt has not yet been proposed. Author

**N64-14528** Joint Publications Research Service, Washington, D.C.
**PROGRESS IN METEOR ASTRONOMY IN 1958-1961**
I. S. Astapovich and V. V. Fedynskiy 3 Feb. 1964 18 p Transl. into ENGLISH of an article from Meteoritika (Moscow), no. 23, 1963
(JPRS-23047; OTS-64-21470) OTS: $0.50

Progress discussed in meteor astronomy includes: (1) the study of meteoric matter in space by means of instruments installed in satellites and rockets; (2) the use of rocket technology to impart escape velocities to bodies and to create artificial meteors in order to experimentally verify theory; (3) the determination of the rate of loss of material from the surface of meteors by the fusion of meteoric material in an air stream at supersonic velocity; (4) the obtainment of data on the ionization of atmospheric gases by the shock wave arising from the flights of meteoric bodies at cosmic velocities; (5) the use of radar to study meteors and the use of meteor phenomena (ionization for example) for long-range radio communications; (6) the study of the true density of meteoric matter in the region of the earth's orbit; (7) the determination of the orbits of a considerable number of meteors; (8) the discovery of meteor streams connected with a number of observed comets; (9) the first photographing of the flight of a bolide that finally fell as a meteorite; and (10) the study of the influence of interplanetary magnetic fields on the formation of the solar system's dust clouds. Also, meteor research during the IGY is discussed. I.v.L.

**N64-14546** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**AN UNSOLVED ASTROMETRICAL PROBLEM**
A. A. Yakovkin [1963] 22 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 39, no. 4, Jul-Aug. 1962 p 736-745
(MH Transl. 430)

The absence is noted of a generally accepted method for the reduction of observations for determining the coordinates

of the center of gravity of the moon. Results of observations at six points are compared. Four models used in the reductions of heliometric observations are described. Author

**N64-14672** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**ON METEOROIDS AND PENETRATION**
Fred L. Whipple [1963] 40 p refs

This report describes the continued work on fabricating miniature thin-film inductors using flat conducting spirals deposited on ferrite substrates and encapsulated with a ferrite-film deposit. Gold spiral coils of 0.67 and 1.58-$\mu$henry air-core inductance have been fabricated on Ceramag 9 ferrite substrates. Methods used to solve the problems of adjacent turn shorting during electroplating and poor adhesion of the pattern to the substrate are described. Samples of the gold spirals have been encapsulated in ferrite film deposited at 800° C to thicknesses of 150$\mu$. An inductance increase over air-core value of only 4 times was obtained, although the permeability of the films has been measured to be 70 or more. Ferrite films deposited at temperatures of 400° to 700° C were also studied. Author

**N64-14717** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**THE INFLUENCE OF THE ORBITAL MOTION OF THE EARTH ON THE DETERMINATION OF THE DISTANCE AND THE VELOCITY IN THE COSMIC SPACE BY MEANS OF RADIO METHODS**
V. M. Vakhnin [1962] 11 p refs Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), no. 13, 1962 p 61–67
(MH-Transl. 456)

This paper investigates the influence of the earth's orbital motion on radar measurements of the range (distance from the earth) and the velocity of a super-remote object relative to the earth. The propagation time of the radiowaves reaches hundreds and thousands of seconds under these conditions; during this time the measuring station moves tens of thousands of kilometers along the orbit of the earth. The orbital velocity of the earth is approximately $10^{-4}$ of the velocity of light, so that the effects of the special relativity theory become noticeable. An interplanetary (or interstellar) medium would influence the velocity of the radiowave propagation and, for a distance of an astronomical unit or more, may cause a noticeable error in the determination of the distance. Author

**N64-14934*** Mellon Inst., Pittsburgh, Pa.
**ASTEROID- OR COMET-IMPACT HYPOTHESIS OF TEKTITE ORIGIN: THE MOLDAVITE STREWN-FIELDS**
Alvin J. Cohen Repr. from "Tektites", Chicago, Ill., Chicago U., 1963 p 189–211 refs
(NASA Grant NsG-57-60)

Aerodynamic analysis indicates that tektites could not have been produced by asteroid impact because they could not have survived passage through the atmosphere. This leaves the proposition that tektites occur in strewn-fields, that they were produced under reducing conditions from terrestrial silicates, and that normally they could not survive passage through the atmosphere and return. Comet impact with the earth appears to be the most likely event for terrestrial production of tektites. The fact that the gases of a volatilized comet would be reducing would account for the composition of tektites upon their primary melting. The large volume of expanding gases from decomposition and vaporization of the comet would safely cushion some of the molten glass up through the atmosphere. Tektites occurring at the far end of extensive strewn-fields, as is the case for javanites and australites, would have outdistanced reacting and reducing gases that propelled them and would reenter an atmosphere that was completely oxidizing in nature. In conjunction with the strewn-field proposition, an attempt is made to relate the moldavite strewn-fields to the Nördlingen Ries Crater by geochemical means and to use the Moldavite–Ries model to indicate a probable relationship between Bosumtwi Crater and the Ivory Coast tektites. I.v.L.

**N64-14953*** New Mexico State U., University Park Research Center
**AN OPTICAL RADIUS OF VENUS FROM PHOTOGRAPHS TAKEN AT INFERIOR CONJUNCTION**
Bradford A. Smith Repr. from Astron. J., v. 68, no. 8, Oct. 1963 p 1313
(NASA Grant NsG-142-61)

Photographs taken during the November 1962 inferior conjunction of Venus have been measured on a model 422-D Mann comparator across a diameter connecting the geometric cusps. The average of 54 measured images gives a radius of 8".486 ± 0".004 (p.e.) at unit distance corresponding to 6155 km ±3 km (p.e.). A survey of all previously available data by de Vaucouleurs (private communication) gives a radius of 8".43 ±0".02 (p.e.) or 6114 km ±14 km (p.e.). The discrepancy may be a property of the method of measurement. Author

**N64-14955** Joint Publications Research Service, Washington, D.C.
**INFLUENCE OF THE FORM OF THE MOON ON ITS MOTION**
V. T. Kondurar' 13 Feb. 1964 17 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 40, no. 4, Jul.–Aug. 1963 p 757–766
(JPRS-23220; OTS-64-21554) QTS: $0.50

The general problem of the translational–rotational motion of two bodies of arbitrary form and arbitrary density distribution is considered. The problem is solved by a first approximation and is reduced to the integration of equations of the Hill type, the general integral of which can be represented in quadratures. New analytical formulas of the first approximation are given for the coordinates of the center of mass of the attracted body and the Euler angles of the attracting and attracted bodies. The perturbations of the moon in the radius vector, the longitude of its center of mass, and the Euler angles are considered. R.T.K.

**N64-15000*** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**MINERALOGY OF THE OXIDATION PRODUCTS OF THE SPUTNIK 4 FRAGMENT AND OF IRON METEORITES**
Ursula B. Marvin Repr. from J. Geophys. Res., v. 68, no. 17, Sep. 1, 1963 p 5059–5068 refs
(NASA Grant NsG-282-63)

The melted and oxidized products on the Sputnik 4 fragment make up 10 to 15 percent of the total mass and consist of droplets of $\alpha$ iron, coated with the iron oxides, wüstite ($Fe_{1-x}O$), magnetite ($FeFe_2O_4$), and akaganéite ($\beta$ FeO(OH)), and the magnesium oxide, periclase (MgO). This assemblage of minerals reflects nonequilibrium conditions of rapid cooling from above 1,535° C, the melting point of iron, to below 80° C, the temperature region in which akaganéite can form as a metastable variety of iron oxyhydroxide. A reexamination of the crust during the fifth month after recovery showed that the akaganéite and some of the wüstite had been oxidized to hematite ($\alpha$ $Fe_2O_3$). Wüstite and akaganéite are metastable

at surface temperatures and are therefore virtually unknown in terrestrial rocks and in meteorites. Their discovery on the Sputnik 4 fragment, however, led to the investigation, by X-ray diffraction procedures, of the crusts of numerous iron meteorites. Author

# 06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic, and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

**N64-14207*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

**ON THE RELATION OF ION AND ELECTRON EMISSION TO DIODE DIAGNOSTICS**

Roland Breitwieser *In* Inst. of Elec. and Electron. Engr. Rept. on the Thermionic Conversion Specialist Conf., Oct. 7-9, 1963 p 17-26 refs (See N64-14204 06-01) GE Res. Lab., $15.00

The detailed understanding of the mechanisms governing the performance of a thermionic converter is confused by the interactions between the electrodes and the plasma in the interelectrode space. A guard-ring variable-spacing diode capable of spacings as small as 8$\mu$ has been used to minimize the electron and the ion transport effects in the plasma. Relations have been established that satisfactorily interrelate electron and ion emissions of an oriented tungsten emitter over a broad range of emitter temperatures and cesium pressures. Work functions based on observed ion currents were determined by the use of the Langmuir-Saha equation. A field effect was noted and was adequately treated by the application of the Schottky mirror-image theory. The work functions determined from ion currents are generally 0.07 ev higher than those obtained by electron emission. Author

**N64-14208*** Radio Corp. of America, Princeton, N.J. RCA Labs.

**GAS ANALYSIS AND GAS DOSING OF CESIUM VAPOR DIODES**

J. R. Fendley, Jr. *In* Inst. of Elec. and Electron. Engr. Rept. on the Thermionic Conversion Specialist Conf., Oct 7-9, 1963 p 129-133 refs (See N64-14204 06-01) GE Res. Lab., $15.00 (NASA Contract NAS3-2531)

An apparatus for the analysis of the outgassing from an operating cesium diode was constructed. This apparatus includes provision for the introduction of known gases. The system, shown in block diagram, consists of a high-vacuum section and a cesium section. R.T.K.

**N64-14209** Thermo Electron Engineering Corp., Waltham, Mass.

**CORRELATIONS OF OBSERVED NON-UNIFORM EMISSION FROM SURFACES IN CESIUM VAPOR**

N. S. Rasor, Sotiris S. Kitrilakis, and D. P. Lieb *In* Inst. of Elec. and Electron. Engr. Rept. on the Thermionic Conversion Specialist Conf., Oct. 7-9, 1963 p 169-178 refs Work Performed for Jet Propulsion Lab., Calif. Inst. of Tech. (See N64-14204 06-01) GE Res. Lab., $15.00

An approach is described by which the effect of surface nonuniformity on converter performance can be unambiguously assessed and diagnosed. New methods developed for the required display of emission from surfaces immersed in cesium vapor are described. Results are presented that show large differences in emission from various single crystal and polycrystalline samples mounted on the same emitter in cesium vapor. The dependence of the observed emission on cesium pressure and surface temperature is in general accord with theoretical expectations. The observed nonuniformity is concluded to be of substantial significance to converter performance. Author

**N64-14210*** Electro-Optical Systems Inc., Pasadena, Calif.

**A DETAILED INVESTIGATION OF MOLYBDENUM AS AN ELECTRODE MATERIAL FOR CESIUM VAPOR THERMIONIC CONVERTERS**

A. O. Jensen, Albert E. Campbell, and W. Dong *In* Inst. of Elec. and Electron. Engr. Rept. on the Thermionic Conversion Specialist Conf., Oct. 7-9, 1963 p 192-201 (See N64-14204 06-01) GE Res. Lab. $15.00 (NASA Contract NAS3-2529)

The results of a detailed investigation of recrystallized polycrystalline molybdenum as an electrode material for cesium vapor thermionic converters are reported. Arc cast molybdenum bar stock and plate stock have been examined. Measurements of cesiated emission and effective work function of plate and bar stock molybdenum at temperature and cesium arrival rates appropriate to practical cesium vapor thermionic converter operating conditions are given ($700^\circ C \leq Te \leq 1530^\circ C$; $\leq 295^\circ C \leq T_{cs} \leq 400^\circ C$). Recrystallized molybdenum emitters have been examined in detail by metallographic means, X-ray diffraction techniques, with a thermionic electron emission microscope, and by electron emission measurements on the cesiated materials. Author

**N64-14213** Thermo Electron Eng. Corp., Waltham, Mass.

**RECENT PROGRESS IN THE DEVELOPMENT OF SOLAR THERMIONIC CONVERTERS**

Sabino G. Merra and J. H. Weinstein *In* Inst. of Elec. and Electron. Engr. Rept. on the Thermionic Conversion Specialist Conf., Oct. 7-9, 1963 p 295-304 (See N64-14204 06-01) GE Res. Lab., $15.00

Results are reported that were obtained during electrical testing of converters under both steady-state and cyclical conditions. Converters have been operated both singly and in series connections. Static and dynamic I-V curves are shown, and steady-state and cycling life test data are presented. Author

**N64-14214** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

**RESULTS OF LABORATORY TESTS OF SET THERMIONIC CONVERTERS AND GENERATORS**

Peter Rouklove *In* Inst. of Elec. and Electron. Engr. Rept. on the Thermionic Conversion Specialist Conf., Oct. 7-9, 1963 p 305-375 refs (See N64-14204 06-01) GE Res. Lab. $15.00

Employing multiconverter generators, System SET (Solar Energy Thermionic) I, now in its second generation of design evolution, has provided an observed maximum output of 82.4 watts at a measured efficiency of 7.5%. Typical current thermionic designs and their evaluation are presented. Author

**N64-14264*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

**A 4-KILOWATT STEAM RANKINE CYCLE SOLAR POWER SYSTEM**

Roy L. Johnsen [1963] 8 p refs Presented at the Symp. on Solar Dynamic Systems, sponsored by the Solar and Mechanical Working Groups of the Interagency Advanced Power Group, Washington, 24–25 Sep. 1963
(NASA TM X-51110; NASA Lewis TP 11-63) OTS: $1.10 ph, $0.80 mf

The merit of using steam in a smaller solar power system, comparable to the Sunflower I, a 3-kw system, was investigated with the purpose of finding any large effects brought about by utilizing steam instead of mercury. Results indicate that the steam system appears to have no significant specific advantage over the Sunflower I. The slightly higher thermodynamic cycle efficiency would enable the steam system to produce more electric power than the mercury system using the same solar collector and heat-storage unit. However, the larger radiator area must be listed as a definite liability to the steam system. I.v.L.

**N64-14265*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**NASA SOLAR BRAYTON CYCLE STUDIES**
Daniel T. Bernatowicz [1963] 16 p Presented at the Symp. on Solar Dynamics Systems, sponsored by the Solar and Mech. Working Groups of the Interagency Advanced Power Group, Washington, 24–25 Sep. 1963
(NASA TM X-51112; NASA-TP-13-63) OTS: $1.60 ph, $0.80 mf

System studies made to date indicate that an 8-kw Brayton cycle system using a rigid 30-ft collector would, at least, be competitive with other solar dynamic power systems and could be conveniently stowed in the launch vehicle if the assumed component performance is realistic. The advantages of the closed Brayton cycle are: (1) inert-gas working fluid; (2) the possibility of high cycle efficiency; (3) the relative ease of start and restart; (4) simpler development problems—absence of zero-g boiling and condensing problems, and noncorrosive working fluid; (5) extensive experience in component design; (6) inherent reliability for long-term operation; and (7) flexibility in application. Because of these advantages, NASA has undertaken a 2-year technology program in this area. I.v.L.

**N64-14266*** Electro-Optical Systems, Inc., Pasadena, Calif.
**VAPOR THERMIONIC CONVERTERS Monthly Progress Report, 27 Sep.-27 Oct. 1962**
A. O. Jensen 1 Nov. 1962 7 p refs
(NASA Contract NAS3-2529)
(NASA CR-52815; EOS-3410-ML-1) OTS: $1.10 ph, $0.80 mf

Activities are reported in the following areas: (1) sample standardization investigations; (2) grain-growth experiments; (3) emission tests; and (4) the emission microscope. R.T.K.

**N64-14279*** Electro-Optical Systems, Inc., Pasadena, Calif.
**BRAYTON CYCLE SOLAR COLLECTOR DESIGN STUDY Monthly Progress Report for November 1963**
D. E. Stewart 15 Dec. 1963 38 p
(NASA Contract NAS3-2782)
(NASA CR-55394; EOS-4150-M-5) OTS: $3.60 ph, $1.34 mf

This report summarizes additional parametric weight analysis, fabrication of samples for micrometeorite degradation tests, computer surface and orientation error analysis, time averaged orientation efficiency computations, blade grinding and polishing, structural analysis in vibration and orbit conditions, and thermal analysis. Author

**N64-14294** Eagle-Picher Co., Joplin, Mo.
**INVESTIGATIONS LEADING TO THE DESIGN OF A RELIABLE SEALED NICKEL-CADMIUM CELL Report No. 6; Second Quarterly Progress Report, 1 Aug.-31 Oct. 1963**
C. O. Gosh [30 Nov. 1963] 98 p refs
(Contract DA-36-039-AMC-00135(E))
(AD-427727)

Design experiment data and response information have been analyzed for the following: a self-discharge experiment (3-month storage); a charge acceptance experiment; and a limited overcharge experiment. The design experiment was delineated, and the response data were detailed for the factors: electrolyte concentration; additives; type of sintered plaque; type of separation; type of negative plate; and type of cell. The results of the analysis of the responses of the cells studied in the above experiments have been recorded, and the influences of the various parameters have been shown. Author

**N64-14302** Monsanto Research Corp., Dayton, Ohio
**HIGH TEMPERATURE THERMOELECTRIC RESEARCH First Quarterly Progress Report 15 Sep.-31 Dec. 1963**
C. M. Henderson, [1963] 70 p refs
(Contract AF 33(615)-1084)
(AD-427285)

This report describes applied research to establish the technical feasibility of utilizing high temperature thermoelectric generators powered with nuclear and solar heat sources for long-lived power supplies for aerospace vehicles. A 50-watt laboratory generator, fabricated of segmented thermoelements and preliminarily tested, was subjected to sustained testing with its hot-junction 1215° C, its cold junction 570° C, and in a vacuum of $10^{-5}$ to $10^{-6}$ torr. This generator exhibited a 12.8 watt/lb performance ratio at an overall thermal efficiency of 2%. The design of an improved experimental generator with a nominal 29 watt(e) output and 15 watts/lb performance is described and results presented on applied research in junction-forming and plasma-spray coating techniques for producing segmented thermoelements. Initial studies of auxiliary power system concepts indicate that, on a minimum weight basis, a cylindrical generator shape is the most promising for radioisotopes, and that a "fast" reactor is best for a nuclear in-pile or an out-of-pile heat source. Author

**N64-14517** Atomics International, Canoga Park, Calif.
**EXPERIMENTAL STRESS ANALYSIS OF 37-TUBE MODULAR STEAM GENERATOR HEAD**
M. M. Lemcoe 30 Jan. 1964 21 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8514) OTS: $0.50

Results are presented of an experiment conducted to determine the stresses at certain critical locations on a 37-tube modular steam generator head, designed for operation at pressures up to 4000 psi and temperatures up to 1100° F maximum. Favorable results of this experiment indicate feasible operation at the design parameters, and lead to the conclusion that a 61-tube head can be constructed. Author

**N64-14556** Atomic Energy Commission, Washington, D.C.
**AEC AEROSPACE SAFETY PROGRAMS AND PHILOSOPHY**
F. K. Pittman *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 39–45 (See N64-14551 06-01) OTS: $4.50

The main points made in the discussion are: (1) The fundamental parameters of missile-abort environments must be experimentally established to form a technically sound basis for aerospace nuclear-safety philosophies and device design. (2)

Aerospace nuclear systems require a flexible safety approach; it is not a case of a single problem with a single solution. (3) As aerospace systems become more complex and more agencies are involved in their integration, work will have to be accomplished on an interagency basis at the beginning of each program. Formal means of accomplishing the interchange of this expertise will enhance the overall safety of the systems. (4) Every effort will continue to be made to minimize the safety barrier to the use of aerospace nuclear systems. R.T.K.

**N64-14558** Atomics International, Canoga Park, Calif.
**DESIGN AND SAFETY ASPECTS OF HYDRIDE FUEL SNAP REACTORS**
D. J. Cockeram and R. L. Detterman *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 55–63 (See N64-14551 06-01) OTS: $4.50
(Contract AT(11-1)-GEN-8)

A discussion is presented that describes the process of optimizing the SNAP reactor design. Also considered are the inherent features determining the physical characteristics of the system, and safeguards incorporated into the final reactor design. R.T.K.

**N64-14559** Atomics International, Canoga Park, Calif.
**SNAP REACTOR TRANSIENT TESTS**
L. I. Moss and T. R. Wilson (Phillips Petrol. Co.) *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 65–78 refs (See N64-14551 06-01) OTS: $4.50
(Contract AT(11-1)-GEN-8)

The determination of consequences of nuclear accidents, and the physics and engineering information of importance to the understanding of the kinetic behavior, assessing the nuclear safety, and improving the design of nuclear systems with respect to safety are the objects of a test program designated as SNAPTRAN, or SNAP Reactor Transient Tests. Tests to provide this information will initially be performed on SNAP-2 and SNAP-10A type reactors, which are small, uranium zirconium-hydride-fueled, beryllium-reflected assemblies. The series of experiments described are to be conducted with the SNAPTRAN-10A/2-3 reactor. This reactor consists of a flight reactor core vessel, less the beryllium reflectors, immersed in water. In the destructive test of this machine, rapid assembly of the water reflector will provide for a large reactivity input before self-destruction. R.T.K.

**N64-14560** Sandia Corp., Albuquerque, N. Mex.
**AEROSPACE NUCLEAR SAFETY GROUND TEST PROGRAM**
J. L. Colp *In its* Aerospace Nucl. Safety Jan. 1964 p 79–89 (See N64-14551 06-01) OTS: $4.50

This program is described as being an effort to assess the effects of mechanical actions, thermal and chemical interactions, and nuclear reactions upon the safety of nuclear power sources intended for aerospace application. The program is responsible for assessing all the possible effects of conceivable accidents between factory shipment and terrestrial reentry. R.T.K.

**N64-14561** Martin Co., Baltimore, Md.
**SAFETY OF ISOTOPIC SNAP GENERATORS**
W. Hagis and D. G. Harvey *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 91–102 refs (See N64-14551 06-01) OTS: $4.50

In establishing a safety philosophy and design criteria for isotopic auxiliary power units in space, the degree of containment of the radioisotope fuel and its radiations was the primary concern. The hazards posed by the use of isotopic power systems are the result of either the release of the isotopic material into the atmosphere or biosphere or the return of the fuel container intact with a large part of its original inventory. Isotopic systems so far developed, SNAP-1A, SNAP-3, and SNAP-9A and Transit 4A and 4B, were required to disassemble and burn up in the stratosphere and to disperse the fuel as particulate matter in worldwide fallout. A description of isotopic SNAP generators is included as well as results of ground and flight test programs. R.T.K.

**N64-14562** Aerojet-General Nucleonics, San Ramon, Calif.
**NUCLEAR SAFETY OF ADVANCED NUCLEAR SPACE POWER PLANTS; NONBOILING LITHIUM-COOLED REACTOR**
D. L. Cochran, J. P. Lehman, and G. H. Anno *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 103–127 refs (See N64-14551 06-01) OTS: $4.50
(Contract AF 29(601)-5131; Contract AF 29(601)-5978)

The assumed operational sequence and corresponding procedures, reactor status, environmental conditions, and possible accidents that could occur with a nonboiling lithium-cooled reactor are summarized as follows: (1) transport to launch site, (2) receipt, inspection, and storage, (3) assembly and checkout, (4) transportation to launch pad, (5) mating reactor system with booster, (6) final combined prelaunch checkout, (7) launch lift-off, pitchover, and stage separation, and (8) orbital startup, mission operation, and disposal. Excursion yields, radiation hazards, reentry considerations, and hazards countermeasures are also discussed. R.T.K.

**N64-14623** Air Force Systems Command, Wright-Patterson AFB, Ohio Flight Dynamics Lab.
**AN INVESTIGATION OF THE ABRUPT ACCELERATION PROPERTIES OF THE PROTOTYPE NET CREW SUPPORT-RESTRAINT SYSTEM Memorandum Report [Jul. 1959-1961]**
Richard L. Peterson Oct. 1963 48 p refs
(FDFR-TM-63-25; AD-428614) OTS: $9.10

Two series of abrupt acceleration experiments are described. The first series included evaluation of the prototype net crew seat utilizing full instrumented and articulated anthropomorphic dummies; the second series included both fully instrumented dummies and human volunteer test subjects. Acceleration-time history oscillograph traces are included for both series of experiments and contain acceleration forces in G units vs time in seconds for the head, chest, and knee, and for the center of gravity and head area of the impact test vehicle. The net crew seat prototypes were only evaluated for unidirectional (+Gx) impact accelerations involving velocity changes that are lower than those encountered in operational systems during ground landing impact. During the human abrupt acceleration experiments conducted at an impact velocity of 15 ft/sec, a peak of 35.5G was recorded on the chest. Analysis of the oscillograph traces and 16-mm movie data revealed a major problem area, seat-occupant oscillation (rebound) during ground impact. Author

**N64-14629** Electrochimica Corp., Menlo Park, Calif. Research and Development Lab.
**DIRECT AMMONIA-AIR FUEL CELL First Quarterly Report, 1 Jul.-1 Oct. 1963**
Robert E. Kuppinger [1963] 43 p refs
(Contract DA-36-039-AMC-03245(E))
(AD-428052)

Electrochemical parameters were investigated for a new type of intermediate-temperature direct ammonia fuel cell. Effects of temperature and composition were studied. Single electrode potentials were measured by means of a nickel–nickel oxide reference electrode. Experimental problems related to difficulties in sealing cells and to electrode flooding are discussed. Theoretical aspects of the ammonia decomposition problem are analyzed. A systematic study plan is discussed. Author

**N64-14645** Ion Physics Corp., Burlington, Mass.
**P-N JUNCTION FORMATION TECHNIQUES Quarterly Technical Progress Report No. 1, 2 Oct. 1963-2 Jan. 1964**
William J. King [1964] 73 p refs
(Contract AF 33(615)-1097)
(AD-428424)

An applied research program has been initiated to increase the state-of-the-art efficiency of solar cells produced by ion implantation techniques and to demonstrate feasibility for producing thin-film solar cells by plasma deposition. A new implantation apparatus has been designed, constructed, aligned, and tested. This machine was specifically designed for fabrication of N on P cells using phosphorous ions. Plasma deposition studies involved an investigation of effects of deposition parameters on characteristics of silicon films deposited on silicon, pyrex, and tantalum. Various deposition system improvements were made, and a quadrupole mass spectrometer was modified to allow analysis of the plasma ion constitution during deposition. Evidence of crystallinity in some of the deposited films has been observed. Author

**N64-14652** Thermo Electron Engineering Corp., Waltham, Mass.
**ADDITIVE CONVERTER STUDIES Third Quarterly Report**
S. S. Kitrilakis Sep. 1963 27 p refs
(Contract AF 33(657)-10130)
(TE-11-64; AD-418276)

A Re emitter–Mo collector converter was tested with Cs and CsF additive. This same converter had been tested previously with Cs only, and its performance agreed well with the documented performance of similar devices. The most significant effect of the CsF observed is a lowering of the collector work function by 0.1 to 0.15 v. This collector work function reduction is evident in retarding plot measurements and in the increase of the output voltages at the "knee" of current–voltage curves. A Re emitter–Mo collector converter was operated for 150 hours with Cs and CsF additive and then subjected to metallurgical examination to reveal any corrosive effects of the CsF. The emitter, collector, and seal structures were examined, and no corrosion attributable to the presence of CsF was detected. Author

**N64-14668** AiResearch Mfg. Co., Los Angeles, Calif.
**DESIGN AND DEVELOPMENT OF A MINIATURE NONRECIPROCATING CLOSED-CYCLE CRYOGENIC COOLER, PHASE 1 Final Report**
G. A. Burgess Los Angeles, AF Systems Command, Jul. 1963 110 p refs
(Contract AF 04(695)-146)
(SS-960; SSD-TDR-63-240; AD-415966)

Work described in this report was largely concerned with the problems of miniaturization of the compressor, turbine, motor, alternator, and heat exchangers. These problems included: gas bearing synthesis and development; refinement of refrigeration cycle analysis to permit selection of operating parameters consistent with feasibility of design of the components; compressor prototype and turbine prototype design and testing; motor preliminary design; alternator design; and heat exchanger development. A miniaturized first-stage compressor impeller and a complete experimental turboalternator were fabricated and tested with reasonable success. Author

**N64-14738** European Atomic Energy Community, Brussels (Belgium)
**IN-PILE TEST OF A THERMIONIC CONVERTER**
C. A. Busse, R. Caron, and E. W. Salmi (Los Alamos Sci. Lab.) Joint Nucl. Res. Center, Ispra Estab. (Italy), Nov. 1963 15 p refs Presented at the Thermionic Converter Specialist Conf., Gatlinburg, Tenn., 7–9 Oct. 1963
(EUR-485.e) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 40 Belg. Fr.

A study was made of the temperature distribution in the converter under different operating conditions. The converter was principally constructed of niobium and alumina, with a cylindrical molybdenum emitter that was radiation heated from a (UZr)C fuel pin. The vacuum-contained converter was in thermal contact with the cooling water through three bridges. Measuring the temperature drop along these bridges allowed direct determination of the emitter lead losses and the converter efficiency. No currents higher than the vacuum saturation emission current were obtained, since the cesium heater failed in the checkout before the test. Author

**N64-14795** Grumman Aircraft Engineering Corp., Bethpage, N.Y.
**THE APPLICATION OF FRIEDRICHS TECHNIQUE TO THE SHIP PROBLEM Final Report**
S. I. Ciolkowski Nov. 1963 40 p refs
(Contract Nonr-3616(00))
(RE-169; AD-428630) OTS: $3.60

This paper considers the problem of a ship moving with uniform velocity over a semi-infinite ocean at rest at infinity. An expansion procedure suggested by Friedrichs is used to arrive at a perturbation of this problem. The perturbation problem is then solved by making use of a Green's function derived by Peters and Stoker. Applying Green's theorem, the perturbation potential is obtained to the second order in the perturbation parameter. The corresponding problem of multiple hull ships is then solved. Wave resistance of the ships is calculated. The problem of fixed-displacement hull shapes having minimum wave resistance for large Froude numbers is studied. Author

**N64-14809** Radio Corp. of America, Harrison, N.J. Special Electronics Components Div.
**THERMOELECTRIC POWER MODULES Second Quarterly Progress Report, 15 Apr.–15 Jul. 1963**
Hans P. Van Heyst 31 Jul. 1963 29 p
(Contract DA-36-039-AMC-00110(E))
(AD-429066) OTS: $2.60

The four modules which were put on life test completed 2000 hours of unattended operation. A hot junction temperature of 800° C was maintained. Satisfactory performance of the modules was observed and the test is continuing. Two additional modules were started on a cycled life test, 1 hr on and 1 1/2 hr off for an 8-hr period, and continuous operation for the remainder of the 24-hr period. These modules completed satisfactorily 80 cycles and 780 hr of operating time at a hot junction temperature of 850° C; the test is continuing. Two other modules were used to confirm analytical computations regarding

power output, internal resistance, and open circuit voltage at different hot junction temperatures (from 500° C to in excess of 1000° C). Author

**N64-14812** Pennsylvania State U., University Park. Mineral Industries Experiment Station
**FURTHER INVESTIGATIONS OF POROUS FLOW-THROUGH ELECTRODES OF PLATINUM BLACK. Report No. 5**
P. Palasi and L. G. Austin. Aug. 1963. 46 p. refs
(Contract DA-49-186-502-ORD-917)
(AD-429063) OTS: $4.60

For methanol, formaldehyde, and formate reactants at high current densities, the observed limiting currents are considerably less than the theoretical values. The same electrodes with the stannous–stannic couple as reactant gave exact agreement between the observed and predicted limiting current. It is concluded that the limiting factor present for the hydrocarbon fuels is not a mass-transport factor. In general, the theoretical predictions of the effect of flow rate, concentration, etc., on the polarization curves are valid at lower current densities, but fail near the region of the abnormal limiting current. Author

**N64-14821** Aerospace Corp., El Segundo, Calif. Engineering Div.
**UMBILICAL QUICK DISCONNECTS**
Ara G. Farajian. 16 Dec. 1963. 19 p
(Contract AF 04(695)-269)
(TOR-269(4303)-4; AD-429087) OTS: $1.60

The function of umbilical quick disconnects is delineated, and the detailed design requirements are enumerated, with special emphasis on the redundancy of the release action. How each design requirement is met is explained through sectional views on existing hardware. Author

**N64-14836** Atomic Energy Commission, Washington, D.C. Div. of Technical Information
**DIRECT ENERGY CONVERSION AND SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP), A LITERATURE SEARCH**
Sidney F. Lanier and Henry D. Raleigh, comps. Jan. 1963. 66 p. refs (See N62-16735 17-07)
(TID-3561(Rev. 3)) OTS: $1.50

This search contains 552 references to publications on the SNAP Program and related topics. The references, taken from *Nuclear Science Abstracts* and covering the issues through December 31, 1962, are grouped into the following subject categories: radioisotope-fueled units, reactor-fueled units, direct energy conversion, and general topics on nuclear auxiliary power. I.v.L.

**N64-14849*** Radio Corp. of America, Princeton, N.J. RCA Labs.
**THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER**
S. G. Ellis, W. L. Hui, H. I. Moss, G. Noel, and P. Vohl. David Sarnoff Res. Center. 31 Dec. 1962. 22 p. refs
(NASA Contract NAS7-202)
(NASA CR-55298) OTS: $2.60 ph, $0.86 mf

Methods are described for the production of n-type and p-type films of gallium arsenide or tungsten and molybdenum sheet. The methods involve the proper choice of source gallium arsenide, ambient atmosphere, substrate preparation and temperature. An extension of these methods has produced p-n structures in the films, some of which have shown photovoltages as high as 0.3 v. Gallium phosphide films have been formed by similar methods; all to date have been n-type. Author

**N64-14863*** Electro-Optical Systems, Inc., Pasadena, Calif.
**RESEARCH PROGRAM RELATED TO VAPOR THERMIONIC CONVERTERS FOR NUCLEAR APPLICATION [First] Quarterly Progress Report, 27 Sep.-27 Dec. 1962**
A. O. Jensen. 16 Jan. 1963. 44 p. refs
(NASA Contract NAS3-2529)
(NASA CR-55387 EOS-3410-Q-1) OTS: $4.60 ph, $1.52 mf

The major objective of this program is to study the effects of long time at high temperatures on the surface crystal structure of polycrystalline molybdenum substrates, and how these changes in surface crystal structure relate to the performance of cesiated molybdenum emitters for use in cesium vapor thermionic converters for nuclear applications. This report contains detailed information on the status of and the results obtained in the following areas: (1) sample processing investigations; (2) grain growth experiments in vacuum and cesium vapor environments; (3) long-term cesiated emission tests from substrates that are undergoing surface crystal changes; and (4) electron-emission microscopic examinations of initially polycrystalline materials that are operated for long times at high temperatures. I.v.L.

**N64-14864** Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center
**ALKALINE BATTERY SEPARATOR STUDY Sixth Quarterly Report, 29 Sep.-28 Dec. 1963**
C. Garvin Oberholzer, J. B. Ockerman, and Ernest Weiss. 13 Jan. 1964. 16 p
(NASA Contract NAS5-2860)
(NASA CR-55414; ESB-7054.6) OTS: $1.60 ph, $0.80 mf

Activities are reported as follows: (1) cellophane modifications—treatment with antioxidants, treatment with tolylene diisocyanate, and treatment with tolylene diisocyanate and antioxidants; (2) ion exchange membranes—electrical resistance in 40% KOH, dimensional change after equilibration in 40% KOH at 90°C, weight increase of the polyethylene matrix after polymerization, and weight loss occurring after neutralization (after equilibration, the membranes are neutralized with acid, dried, and the weight loss calculated); (3) diffusion and reaction of silver ions in separators—modified polymer, modified cellophanes, and sausage casing. R.T.K.

**N64-14872** Pratt and Whitney Aircraft, Middletown, Conn.
**LCRE SECONDARY COOLANT PUMP AND SUMP Design Summary Report**
C. Ferguson et al. 10 Jan. 1964. 33 p. refs
(Contract AT(30-1)-2789)
(PWAC-385) OTS: $0.75

Presented is a design summary report on a NaK pump and sump unit. This report covers all work accomplished in the design phase, including analytical design studies. The NP-1 pump and sump unit was designated for use in the Lithium-Cooled Reactor Experiment (LCRE) to circulate 700° F NaK (22 percent Na–78 percent K), designated NaK-78, for 10,000 hr without maintenance. All components in contact with NaK-78 are fabricated of type-316 stainless steel. Author

**N64-14903*** Alfred U., N.Y.
**FUEL CELL RESEARCH: AN INVESTIGATION OF NON-STEADY-STATE OPERATION Semiannual Status Report No. 1, Jun.-Dec. 1963**

T. J. Gray and A. A. Schneider 15 Jan. 1964 19 p
(NASA Grant NsG-384)
(NASA CR-52890) OTS: $1.60 ph, $0.80 mf

The use of fuel cells as a method for the fundamental study of nonequilibrium reactions kinetics is discussed. Using a fuel cell operating under load, it is possible by a material balance, electrical output, and thermal characteristics to achieve a very exact study of nonequilibrium kinetics. A load circuit was designed that permits operation to approximately 3 amps total (readily increased to 10 ohms) with provision for reference electrode measurements during the off-duty cycle under essentially open-circuit conditions ($10^{10}$ ohms, approximately). Provision is included for measurement on a Varian recorder under slower operating conditions and for oscilloscope presentation at higher pulse rates. In addition, a precision galvanometer was developed. Using a constant current technique, the change in potential of several electrodes was studied as a function of time. In conjunction with the recently developed galvanostatic techniques, the above mentioned method should provide information of profound importance for a wide variety of catalytic processes. I.v.L.

**N64-14904*** Goodyear Aerospace Corp., Akron, Ohio
**INVESTIGATION OF THE OPTICAL CHARACTERISTICS OF THE CONE-AND-COLUMN DOUBLE REFLECTOR CONCENTRATOR Final Report**
J. W. Haylett Nov. 1963 124 p refs
(NASA Contract NAS1-3140)
(NASA CR-52845; GER-11292) OTS: $10.10 ph, $3.92 mf

The feasibility of using the Cone-and-Column, double-reflector, solar concentrator for space applications is discussed. Testing of the cone, concentrator testing, and a computer analysis of the system optics are described. Author

**N64-14962** Cook Electric Co., Dayton, Ohio Inland Testing Labs.
**ALKALINE BATTERY EVALUATION Sixth Semi-Annual Report, 30 Jun. 1960–16 Sep. 1963**
W. W. Clark, W. G. Ingling, I. F. Luke, and E. A. Roeger, Jr. Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1963 382 p refs
(Contract AF 33(616)-7529; Contract AF 33(657)-8450)
(RTD-TDR-63-4144; supersedes ASD-TDR-63-394, ASD-TDR-62-893, ASD-TDR-62-553, ASD-TDR-62-68, and ASD-TR-61-236; AD-429135)

This report includes the final results of cycle-life performance tests on 240 12-amp-hr nickel–cadmium cells in groups of 10 cells and batteries of 20 cells. These units were cycled in four temperature environments with four depths of discharge in each environment. The 90-minute cycle period consisted of 55 minutes of charge and 35 minutes of discharge. Also included are the results on current cycle-life performance tests on two types of 25 amp-hr silver–zinc cells and one type of 15 amp-hr silver–cadmium cell being cycled in groups of 8 cells in 2-hour and 24-hour simulated orbit periods, and two types of 20-amp-hr nickel–cadmium cells cycled in a 90-minute cycle. Author

**N64-14990** Textron Electronics, Inc., Sylmar, Calif. Heliotek
**HIGH EFFICIENCY SILICON SOLAR CELLS Fifth Quarterly Progress Report, 15 Jun.–15 Sep. 1963**
Paul A. Berman [1963] 50 p
(Contract DA-36-039-SC-90777)
(AD-428999)

A preliminary statistical experiment has been performed on $n^+/p$ cells having between 5 and 27 grid lines with diffusion times of 20 and 80 min. Half the cells were coated with silicon monoxide and half were not. The results of the experiment show a flat optimum between 9 and 18 grid lines, and between the diffusion times of 20 and 80 min. With regard to the latter variable, the relative insensitivity of $n^+/p$ cell efficiencies, as compared to $p^+/n$ cell efficiencies, with variation of junction depth was once again observed, and this insensitivity caused some difficulty in determining a clear superiority of one diffusion time over the other due to the masking effects of other variables. Cells having total cell series resistances of less than 0.20 ohms were fabricated in the course of the experiments. Author

# 07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

**N64-14225** Iowa State U. of Science and Tech., Ames
**THE CATION EFFECT ON ACID-BASE REACTIONS IN FUSED ALKALI NITRATES**
James Alfred Luthy (M. S. Thesis) and F. R. Duke 1 Oct. 1963 45 p refs
(Contract W-7405-eng-82)
(IS-742) OTS: $1.25

An oxygen electrode was used in conjunction with a glass-silver nitrate-silver electrode to determine the effect of a change of the cation ratio on the decomposition reaction of nitrate ion by pyrosulfate ion. The reaction was carried out in various mixtures of sodium and potassium nitrate and in pure sodium nitrate. The reaction was found to be more complicated at 300° C than has been reported at lower temperatures. The reaction could not be carried out in mixtures containing more than 60 mole percent potassium nitrate or in pure potassium nitrate because of some change in the electrode system. It was found that the log K varied linearly with change in mole percent potassium nitrate. The equilibrium constant was found to increase with an increase in mole percent of potassium nitrate. It was also found that the rate constant decreased with an increase in mole percent potassium nitrate. Author

**N64-14241** Phillips Petroleum Co., Idaho Falls, Idaho
**AN IMPROVED AQUEOUS PROCESS FOR ZIRCONIUM ALLOY NUCLEAR REACTOR FUELS. PART II, CONTINUOUS DISSOLUTION WITH 5*M* HYDROFLUORIC ACID**
B. J. Newby AEC, Natl. Reactor Testing Station 25 Sep. 1963 17 p refs
(Contract AT(10-1)-205)
(IDO-14619) OTS: $0.50

Modification of the existing batch hydrofluoric acid process, to provide continuous dissolution, appears to be the most practicable way to install a high-capacity process for uranium–zirconium alloy fuels. Dissolution in about 5*M* hydrofluoric acid is preferred because it results in the dissolution of fuels containing higher percentages of uranium and in solutions more stable with respect to zirconium and fluoride salts, than do higher concentrations of hydrofluoric acid. All of the zirconium and uranium and one-third of the tin in a 2.5-percent uranium–Zircaloy-2 fuel can be dissolved continuously and retained in solution with 5*M* hydrofluoric acid at a dissolution temperature of 60° to 80° C and a dissolver feed-rate to fuel-surface ratio of 0.04 cm/min. The hydrofluoric acid also readily

attacks oxidized zirconium alloy. Oxidants are not necessary in the dissolution. The dissolver product contains only a trace of zirconium-fluoride salts, even after standing for several months. Author

**N64-14248** Atomic Energy Commission, New Brunswick, N.J.
**BORON SCRAP RECOVERY BY PYROHYDROLYSIS**
A. R. Eberle, L. J. Pinto, and M. W. Lerner Jan. 1964 11 p refs
(NBL-206) OTS: $0.50

A pyrohydrolysis procedure is being tested for the recovery of boron-10 from scrap boron-10 materials. Steam at 950° C is led into a nickel reaction tube and passed over the sample held in nickel trays. The boric acid in the condensate is converted to potassium fluoborate by treatment with potassium hydroxide and hydrofluoric acid. Scrap consisting chiefly of boron carbide and the ash from boron-impregnated tape have been pyrohydrolyzed successfully. The product assays greater than 98% potassium fluoborate. Author

**N64-14292*** New York U., N.Y.
**NITRIC OXIDE PHOTOLYSIS Status Report No. 4, 1 Jun.-30 Nov. 1963**
Algird G. Leiga [1963] 6 p
(NASA Grant NsG-217-62)
(NASA CR-55308) OTS: $1.10 ph, $0.80 mf

The quantum yield of $N_2$ production was found to increase in pressure of NO from 10 to 100 mm Hg and remained approximately constant thereafter to higher pressures, yielding a limit of about 0.5. The rate of yields of $NO_2$ to $N_2$ averaged 2, while that for NO decomposed to $N_2$ produced about 4. The quantum yield of $NO_2$ production approached 1.0 as a limit at higher NO pressures indicating that only one oxygen atom was produced for each nitrogen atom. During the photolysis of 12 mm NO, using the hydrogen discharge, a pressure decrease was observed. The energy of the krypton discharge was found to ionize NO. The similarity of the krypton data to those of hydrogen and xenon indicated that the ion-electron reaction produced an excited state that decomposed in a similar manner to the direct photolysis. R.T.K.

**N64-14339** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**VISUAL OBSERVATIONS OF INTRA-DRUM PROCESSES OF AN OPERATIONAL BOILER**
M. D. Panasenko, A. Ya. Antonov, V. N. Fomina, and Yu. V. Kozlov *In its* Heat Power Eng., Selected Articles 11 Oct. 1963 p 13-20 refs (See N64-14337 06-01)

Data of direct measurements of the water level in the drum are compared with indications of the water level read from water metering columns. R.T.K.

**N64-14361** Victoria U. of Manchester (Gt. Brit.)
**THE THERMOCHEMISTRY OF ALKYLS OF GROUPS III AND IV Final Technical Report No. 2, Oct. 1962-Sep. 1963**
J. V. Davies, A. E. Pope, W. V. Farrer, and H. A. Skinner 30 Sep. 1963 40 p refs Presented in part at Symp. on Thermodynamics and Thermiochem., Lund, Sweden, Jul. 1963
(Contract DA-91-591-AUC-2683)
(AD-428393) ASTIA: $1.10

The topics discussed are: (1) thermochemistry of boron alkyls—diborane and isobutene, diborane and ethylene, diborane and butadiene, and isoprene; (2) the thermochemistry of tin alkyls—heat of combustion of tetrapropyl tin, of tetrabutyl tin, and of tetraphenyl; bond strengths of C-Sn links, heats of redistribution reactions of $SnR_4$ and $SnCl_4$, and di-*tert*-butyl tin; and (3) thermochemistry of germanium alkyls—combustion of tetraethyl germanium. R.T.K.

**N64-14431** Sandia Corp., Albuquerque, N. Mex. Livermore Lab.
**INFRARED SPECTROPHOTOMETRIC ANALYSIS OF URETHANE COMPOUNDS**
H. L. Brumfield Dec. 1963 70 p refs
(SCR-322) OTS: $1.50

This report presents a simple, quantitative, analytical method for determining the percent of a particular group or structure within a urethane compound by means of the infrared spectrophotometer. The overall objectives and results of this study are summarized, and the advantages of this method are explained. Author

**N64-14433** California U., Riverside
**Final Technical Report, 1 Sep. 1962-31 Oct. 1963 [ISOLATION AND CHARACTERIZATION OF $B_{20}H_{19}^{-3}$ AND $B_{20}H_{18}^{-4}$ IONS AND REACTION OF $B_{20}H_{18}^{-2}$ ION WITH HYDROXIDE ION]**
M. Frederick Hawthorne [1963] 5 p refs
(Contract N123(62738)30950A(X))

The ceric oxidation of $B_{10}H_{10}^{-2}$ produced a double salt (I), $B_{20}H_{18}^{-2} \cdot B_{20}H_{19}^{-3} \cdot 5(C_2H_5)_3\overset{+}{N}H$. Treatment of (I) with aqueous tetramethylammonium chloride precipitated a white tetramethylammonium salt (II). Crystallization of a 1:1 mixture of II and authentic triethylammonium $B_{20}H_{18}^{-2}$ from water afforded I in 70% yield. The reaction of one formula weight of II with aqueous potassium hydroxide liberated 2.98 moles of triethylamine and consumed 4.05 moles of hydroxide ion.

$$B_{20}H_{19}^{-3} + 3(C_2H_5)_3\overset{+}{N}H + 4OH^- \rightarrow B_{20}H_{18}^{-4} + 3(C_2H_5)_3N + 4H_2O.$$

The resulting potassium salt (III) accepted one proton upon potentiometric titration with aqueous acid. Addition of tetramethylammonium ion to an acidified solution of III produced a salt identical to that obtained directly from I. The $B_{20}H_{19}^{-3}$ ion exhibits a $pK_A$ of 6.3. Also, it is indicated that the hydroxide cleavage of the $B_{20}H_{18}^{-2}$ ion results in the cleavage of one B-H-B three-center bond and abstraction of a proton from the second bridge position. The resulting product is a substituted $B_{20}H_{18}^{-4}$ ion that gives reaction characteristics of the $B_{20}H_{18}^{-4}$ ion. I.v.L.

**N64-14475** FMC Corp., Princeton, N.J. Chemical Research and Development Center
**QM ELASTOMER CONTRACT Progress Report 1, 26 Jun.-26 Sep. 1963**
J. A. Gannon 22 Oct. 1963 14 p refs
(Contract DA-19-129-AMC-147(N))
(PCR-337; AD-428799) OTS: $1.60

The reaction of tetrafluoroethylene with fluoro-olefinic silanes has been shown to occur at elevated temperatures to form products containing a perfluorinated cyclobutane ring. Although conversions were low, the reaction provides a basis for further studies involving difunctional moieties which can lead to novel block copolymer systems comprised of siloxane units and fluorocarbon units in alternating sequences. Author

**N64-14487** Ethyl Corp., Baton Rouge, La.
**RESEARCH ON LIGHT METAL FUELS AND OXIDIZER CHEMISTRY PART II: RESEARCH ON OXIDIZER CHEMISTRY Quarterly Progress Report No. 2, Aug.-Oct. 1963**

W. E. Becker, D. H. Campbell, W. B. Krisch, and S. E. Cook [1963] 11 p refs
(Contract AF 04(611)-9376; ARPA Order 24)
(EC-572; AD-427836)

The work on metal-difluoramine compounds has been devoted to the investigation of four different reactions: (1) The possibility of utilizing aprotic solvents to promote halogen displacement on nitrogen has been investigated. (2) The reaction of tetramethylammonium fluoride with difluoramine apparently yields a low-temperature stable complex which explodes on warming. (3) Tetramethylammonium amalgam reacted with difluoramine explosively. (4) A brief attempt to form a chromium-$NF_2$ compound by $N_2F_4$ displacement of carbonyl in chromium hexacarbonyl was unsuccessful. Investigation of the electrochemistry of $NF_2$ compounds is proceeding along two lines: (1) The effect of electrode material on the products of the electrolysis of $HNF_2$ in dimethylsulfoxide solution has been investigated. (2) An investigation of the physicochemical properties of $ClNF_2$ has been initiated. Author

**N64-14507** Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
**CONTRIBUTION TO THE CHEMISTRY OF THE Si-N BOND. I. PREPARATION AND DECOMPOSITION OF CYCLIC N-SILYLATED SILAZANES**
Walter Fink 14 Jan. 1963 14 p refs Transl. into ENGLISH by JPRS from Helv. Chim. Acta (Basel), v. 45, no. 127, 1962 p 1081–1089
(RSIC-119; AD-428323)

Hexamethylcyclotrisilazane and octamethylcyclotetrasilazane give, with butyllithium, N-lithium cyclosilazanes, which upon reaction with trimethylchlorosilane furnish N-silylated cyclosilazanes. The latter are, in part, unstable—they exhibit decomposition reactions as well as inter- and intramolecular silyl migrations; the stable end products are di-N-silylated cyclic di-, tri-, and tetrasilazanes. Author

**N64-14512** Brussels U. (Belgium) Lab. of Molecular Chem. Phys.
**VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURES. PART XV. THE DISSOCIATION AND POLYMERIZATION ENERGIES OF GROUP IV – GROUP VI MOLECULES**
J. Drowart and R. Colin Wright-Patterson AFB, Ohio, AF Materials Lab., Nov. 1963 19 p refs
(Contract AF 61(052)-225)
(WADD-TR-60-782, Pt. 15; AD-426801)

A summary of the mass spectrometric investigation of the vapor phase of group IV–group VI compounds is given. Thermochemically obtained values for the dissociation energies of the MeX molecules are compared to the spectroscopic values. Polymerization energies of MeX and atomization energies of $MeX_2$ molecules are presented. Author

**N64-14513** Brussels U. (belgium)
**VAPORIZATION OF COMPOUNDS AND ALLOYS OF HIGH TEMPERATURE. PART XVIII. MASS SPECTROMETRIC AND KNUDSEN CELL VAPORIZATION STUDIES OF $II_b$-$VI_b$ COMPOUNDS**
P. Goldfinger and M. Jeunehomme Wright-Patterson AFB, Ohio, AF Materials Lab., Nov. 1963 53 p refs
(Contract AF 61(052)-225)
(WADD-TR-60-782, Pt. 18; AD-426820)

The vaporization process of the compounds of Zn, Cd, and Hg with S, Se, and Te has been studied by mass spectrometry. The heat of decomposition of all these compounds to Me(g)+ 1/2 $X_2$(g) has been measured by the mass loss Knudsen technique. The data are compared to literature data. Heats of atomization of these compounds are compared to isosteric compounds, and upper limits for the dissociation energies of the gaseous molecules are given. Author

**N64-14514** Brussels U. (Belgium)
**VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURES. PART XIX. MASS SPECTROMETRIC DETERMINATION OF THE DISSOCIATION ENERGY OF THE MOLECULES $Sc_2$, $Y_2$, $La_2$ AND YLa**
G. Verhaegen, S. Smoes, and J. Drowart Wright-Patterson AFB, Ohio, AF Materials Lab., Nov. 1963 10 p refs
(Contract AF 61(052)-255)
(WADD-TR-60-782, Pt. 19; AD-426819)

The diatomic molecules $Sc_2$, $Y_2$, $La_2$, and YLa have been identified mass spectrometrically in the vapors above condensed scandium, yttrium, lanthanum, and Y-La alloys, respectively. Their dissociation energies are $D:(Sc_2) = 25.9 \pm 5$, $D:(Y_2) = 37.3 \pm 5$, $D:(La_2) = 57.6 \pm 5$, and $D:(YLa) = 47.3 \pm 5$ kcal/mole. Author

**N64-14616** Oregon State U., Cowallis
**STUDIES OF GASEOUS REACTIONS Progress Report, 1 Apr. 1963–1 Oct. 1963**
David S. Burch [1963] 3 p
(Grant DA-ARO(D)-31-124-G267; Contract DASA-WEB 07-010)
(AD-428624) OTS: $1.10

A project for measurement of the three-body recombination coefficient of atomic nitrogen has been concluded successfully. Final measurements were made with a teflon-lined, quartz, cylindrical EPR (electron paramagnetic resonance) cavity operated in the TM010 mode. C.L.W.

**N64-14644** Rock Island Arsenal Lab., Ill.
**IMPROVEMENT OF HIGH TEMPERATURE PROPERTIES OF A FLUOROELASTOMER Technical Report**
E. W. Bergstrom 14 Oct. 1963 17 p refs
(Rept. 63-3347; AD-427892) OTS: $0.75

Sixty-eight chemicals were evaluated as curatives for vinylidene fluoride/hexafluoropropylene (FPM) in an attempt to improve the retention of physical properties when measured at high temperatures. Several chemicals were found to be effective curatives for thin (0.075 to 0.085 in.) specimens. However, when thicker (0.5 in.) pieces were postcured they became porous and puffy. Efforts to eliminate this porosity were unsuccessful. Certain elastomers and thermosetting resins, when used as additives in N,N'-dicinnamylidene-1, 6-hexanediamine-cured FPM, significantly improved the tensile strength of the vulcanizates when measured at high temperature. An increase in tensile strength of more than 96% at 400°F was found in one instance. Porosity was not a problem with these vulcanizates. Attempts were also made to improve the properties at high temperature by using irradiation (gamma) curing. No significant improvement was found. Author

**N64-14647** Naval Research Lab., Washington, D.C.
**SOLVENT-INDUCED EFFECTS ON INFRARED SPECTRA [Interim Report]**
R. E. Kagarise 24 May 1963 16 p refs
(NRL-5906; AD-407429)

The historical development of theories for solvent-induced infrared frequency shifts is given, and several of these theories are then examined in the light of accurate experimental data

The bulk dielectric theory of Buckingham predicts that the ratio of the integrated intensity of an absorption band and the square of its frequency is an isotopic invariant. This prediction is checked using the C—H and C—D stretching bands of $CHCl_3$ and $CDCl_3$; $CHCl_2Br$ and $CDCl_2Br$; and $CHBr_3$ and $CDBr_3$. Ratios of 1.73, 1.54, and 1.20, respectively, are observed. Theoretical band contours resulting from two overlapped bands are computed for various band maxima separations, and the effect of intensity changes of the individual bands on the shape of the resultant contour is discussed. These theoretical predictions are then applied to the interpretation of a number of mixed solvent studies that show the complexity of most solvent–solute interactions. These techniques are applied to the 750 $cm^{-1}$ band of tetralin and the 680 $cm^{-1}$ band of benzene which are unusual bands in that they show a blue-shift with increasing solvent polarity. Author

**N64-14670** Radiation Applications, Inc., Long Island City, N.Y.
**A STUDY OF THE MECHANISM OF RADIATION-INDUCED GELATION IN MONOMER-POLYMER MIXTURES [Semi-Annual Report] 1 May 1961–31 Oct. 1963**
Bruce S. Bernstein and George Odian 30 Nov. 1963 100 p refs
(Contract AT(30-1)-2816; Contract AT(30-1)-2554)
(RAI-329) OTS: $2.25

Polyfunctional monomers such as allyl methacrylate, allyl acrylate, and diallyl maleate have been found to greatly enhance the radiation crosslinking of many polymers. The radiation dose for incipient gelation of polyethylene is reduced by a factor of approximately 25; for polypropylene, the factor is 1,500. Normally degradable polymers such as polyisobutylene and cellulose acetate have been readily crosslinked at doses less than 1 mrad. The ultimate scission/crosslinking ratio for polyethylene and polypropylene is unchanged by the presence of monomer, and the swelling behavior of the gels follows the Flory–Rehner equation. Physical properties of the monomer-crosslinked polyethylene are markedly improved over the straight crosslinked polymer. High-temperature properties of all polymers are improved. Author

**N64-14710** West Virginia U., Morgantown
**PREPARATION OF WOOD-PLASTIC COMBINATIONS USING GAMMA RADIATION TO INDUCE POLYMERIZATION Interim Report**
James A. Kent, Anthony Winston, and W. R. Boyle Washington, AEC Div. of Tech. Inform., 1 Sep. 1963 83 p refs
(Contract AT (40-1)-2945)
(ORO-612) OTS: $2.00

Studies have demonstrated that the shear strength and static bending strength of wood–plastic combinations prepared by the use of gamma radiation are superior to those of the corresponding unmodified wood. The source of radiation was discussed along with the properties of wood–plastic combinations, the chemistry of polymerization in wood, and the impregnation of wood. C.L.W.

**N64-14713** Union Carbide Nuclear Co., Oak Ridge, Tenn.
**PREPARATION OF ANHYDROUS DEUTERIUM FLUORIDE BY DIRECT COMBINATION OF THE ELEMENTS**
S. T. Benton, R. L. Farrar, Jr., and R. M. Mc Gill 29 Jan. 1964 13 p refs
(Contract W-7405-eng-26)
(K-1585)

A flame reactor was designed and constructed to produce 12 lb of deuterium fluoride by the reaction of deuterium gas with fluorine. The system operated with excess fluorine, and the flame was smoothly ignited with a hot nickel wire igniter. An anhydrous product of very high purity was obtained. Author

**N64-14782** Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
**THE INFRARED SPECTROSCOPY OF ORGANIC SUBSTANCES IN THE 1–4 RANGE**
E. Fahr and W. P. Neumann (Julius-Maximilians U.) 18 Apr. 1963 5 p refs Transl. into ENGLISH from Angew. Chem. (E. Germany), v. 67, 1955 p 277
(RSIC-7; AD-429019)

A method is given for the production of unclouded potassium-bromide plates used in the spectroscopy of organic substances in the 1 to 4 mu range. With plates produced by the method given, the spectra of a series of diazo compounds, uracil, homopurin, and triazol derivatives are recorded in the 1 to 15 mu range. Diazobenzil, diazo-benzoyl-acetone, diazo-dimethyl-dehydroresorcin, diazo-tetronic acid, dibenzoyl-diazomethane, and several perchlorated compounds are also tested without premature clouding. C.L.W.

**N64-14802** Bureau of Mines, Rolla, Mo. Metallurgy Research Center
**HYDROMETALLURGICAL RECOVERY OF MANGANESE FROM MANGANIFEROUS SLIMES AND LIMESTONES**
W. L. Falke 1964 18 p refs
(BM-RI-6361)

The procedure is a low-temperature modification of the carbamate process, in which manganese is dissolved and the valence reduced by treating slimes and limestones with controlled amounts of sulfurous acid. Manganese (II) hydroxide is precipitated and leached with ammonium carbamate solution, and manganese carbonate is separated by warming the leach solution. A major portion of the reagents is regenerated and recirculated. About 75 percent of the total manganese in manganiferous slimes, and from 50 to 75 percent of the total manganese in manganiferous limestones, are recovered as manganese carbonate containing 45-percent manganese. Author

**N64-14818** London U. (Gt. Brit.) Royal Free Hospital School of Medicine
**THE USE OF UREA DERIVATIVES IN HETEROCYCLIC SYNTHESIS First Quarterly Technical Status Report, 1 Oct.–31 Dec. 1963**
[1963] 5 p
(Contract DA-91-591-EUC-2894)
(AD-429064)

Reactions involving aliphatic and aromatic isothiocyanates with diguanides are reviewed. In general, this group of reactions may be visualized as proceeding by the primary addition of the isothiocyanate to the diguanide, followed by the elimination of ammonia, or hydrogen sulfide from the intermediate, to yield various s-triazine-derivatives. The action of the alkyl and aryl isothiocyanates on the parent compound, diguanide, in dimethylformamide or pyridine, yields a series of 1-substituted 2-thiono-4,6-di-iminohexahydro-s-triazines. The compounds are bases, forming monopicrates, diacetyl, and dibenzoyl derivatives. The presence of exocyclic sulfur is confirmed by the formation of an S-benzyl derivative. The synthesis of 1-p-methoxyphenyl-2-thiono-4,6-di-iminohexahydro-s-triazine from diguanide and p-methoxyphenyl isothiocyanate is described in detail. I.v.L.

**N64-14860*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

**REACTION RATES OF HYDROGEN, AMMONIA, AND METHANE WITH MIXTURES OF ATOMIC AND MOLECULAR OXYGEN**

Edgar L. Wong and A. E. Potter, Jr. Repr. from J. Chem. Phy., v. 39, no. 9 1 Nov. 1963 p 2211–2217 refs

(NASA RP-120)

The stirred-reactor technique was used to measure the reaction rates of $H_2$, $NH_3$, and $CH_4$ with mixtures of atomic and molecular oxygen ($O + O_2$) at temperatures ranging from 350° to 600° K. A mass spectrometer capable of detecting atomic oxygen and hydrogen was used to analyze the reacting mixture in the stirred reactor. It was discovered that atomic oxygen could be quantitatively monitored by the mass spectrometer at a mass-to-charge ratio of 8. The reaction of $H_2$ with the $O + O_2$ mixture was found to be a chain reaction, with four to six atoms of oxygen consumed for each hydrogen molecule. The rate constant for the disappearance of atomic oxygen was $3 \times 10^{13} \exp(-8300/RT)$ cc $mole^{-1}$ $sec^{-1}$. The products of the reaction were $H_2O$ and H. The reactions of $NH_3$ and $CH_4$ with the $O + O_2$ mixture were complex chain reactions, with a minimum of eight atoms of oxygen disappearing for each molecule of $NH_3$ or $CH_4$. Rate constants for atomic-oxygen disappearance were $3 \times 10^{12} \exp(-4800/RT)$cc $mole^{-1}$ $sec^{-1}$ and $2 \times 10^{13} \exp(-6900/RT)$cc $mole^{-1}$ $sec^{-1}$, respectively. Author

**N64-14865*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

**MICROWAVE SPECTRUM, QUADRUPOLAR COUPLING CONSTANTS, AND DIPOLE MOMENT OF CHLOROBENZENE**

Robert L. Poynter Repr. from J. Chem. Phys. v. 39, no. 8, 15 Oct. 1963 p 1962–1966 refs

(NASA Contract NAS7-100)

(NASA CR-55415; JPL-TR-32-488)

The microwave spectrum of chlorobenzene has been observed in the frequency range between 8,000 and 30,000 mc/sec. An analysis of this spectrum gives the following values for the rotational constants for the two isotopic species, $C_6H_5Cl^{35}$ and $C_6H_5Cl^{37}$; $A = 5672.951$ mc/sec, $B = 1576.774$ mc/sec, $C = 1233.672$ mc/sec for the $Cl^{35}$ isotopic species, and $A = 5672.530$ mc/sec, $B = 1532.790$ mc/sec, $C = 1206.571$ mc/sec for the $Cl^{37}$ isotopic species. The quadrupolar coupling constants that were obtained from the quadrupolar hyperfine structure are $eqQ = 71.10$ mc/sec for $Cl^{35}$ and $eqQ = -56.10$ mc/sec for the $Cl^{37}$. The quadrupolar asymmetry parameter $\eta$ cannot be determined from the microwave spectrum. The observed dipole moment is 1.78 ±0.60 D. Author

**N64-14882** Bureau of Mines, Rolla, Mo. Rolla Metallurgy Research Center

**HIGH-TEMPERATURE CORROSION STUDIES: A SENSITIVE VOLUMETRIC APPARATUS FOR DETERMINING GAS-SOLID REACTION KINETICS**

Robert M. Doerr and Charles C. Myers 1964 17 p refs

(BM-RI-6359)

The apparatus described was developed for determining the kinetics of gas–solid reactions at high temperatures by measuring the volume of gas consumed with respect to time. This apparatus consists essentially of a horizontal, precision-bore glass tube connecting a small reaction chamber in a furnace to a large constant-temperature reservoir. A drop of mercury in the tube separates the two sides of the system and serves as an indicator that moves at a speed proportional to the rate of gas consumption. The sensitivity of the apparatus depends inversely on both the density of the gas in the system and the cross-sectional area of the tube: with a tube having an area of 0.079 $cm^2$, the sensitivity for oxygen at 308° K and 0.5 atm is 20 cm/mg. The reproducibility of data with the volumetric apparatus is good. Author

**N64-14886** Iowa State U. of Science and Tech., Ames Ames Lab.

**SEPARATION OF VARIOUS CATIONS BY REVERSED-PHASE PARTITION CHROMATOGRAPHY USING NEUTRAL ORGANOPHOSPHORUS COMPOUNDS**

Jerome W. O'Laughlin and Charles V. Banks May 1963 145 p refs

(Contract W-7405-eng-82)

(IS-737) OTS: $2.50

The use of neutral organophosphorus compounds and particularly bifunctional compounds such as methylene di-isoalkyl phosphorus oxide as stationary phases is considered. Especial attention is given to the use of bis(di-n-hexylphosphinyl)methane (HDPM) as a stationary phase. Results obtained using this compound are compared with those obtained using tri-n-butyl phosphate (TBP) and tri-n-octyl phosphine oxide (TOPO). A large number of cations are readily separated on papers impregnated with TBP, TOPO, or HDPM. The high partition coefficient for many cations, especially from perchloric acid media, into HDPM make this compound particularly useful as a stationary phase. Separations of particular interest achieved on treated papers include Li from Na; Be, Mg, Ca, and Sr (or Ba) from each other; and the separation of the lanthanides from each other. Author

**N64-14887** Iowa State U. of Science and Tech., Ames Ames Lab.

**SPECTROPHOTOMETRIC STUDY OF THE GASEOUS EQUILIBRIUM OF CADMIUM AND CADMIUM (II) CHLORIDE**

Buddy L. Bruner and J. D. Corbett Nov. 1963 73 p refs

(Contract W-7405-eng-82)

(IS-739) OTS: $1.75

Gas phase absorption spectra were taken of cadmium metal, cadmium(II) chloride, and their mixtures, both as all gaseous systems and over the condensed phases. The mixed systems displayed a series of bands in addition to the characteristic metal and dichloride transitions. The new systems were headed by doublet transitions at 3070 and 3170 A and were found to correspond to the monohalide, CdCl. Quantitative studies of three gaseous mixtures of varying compositions were analyzed over the temperature range from 660° to 780° K. These data yielded a value of 34.15 ±0.5 kcal/mole for $\Delta H°_{1000}$ of the reaction, $CdCl_2(g) + Cd(g) = 2CdCl(g)$. Experimental and estimated values of the heat of the reaction, $MX_2(g) + M(g) = 2MX(g)$, for the group IIb metals and their metal halides were tabulated. The vibrational bands of CdCl were tabulated and analyzed as a $^2\pi_{1/2}$–$^2\Sigma$ system. Author

**N64-14888** Oak Ridge National Lab., Tenn.

**REDUCTION OF URANIUM HEXAFLUORIDE RETENTION ON BEDS OF MAGNESIUM FLUORIDE USED FOR REMOVAL OF TECHNETIUM HEXAFLUORIDE**

Sidney Katz 31 Jan. 1964 13 p refs

(Contract W-7405-eng-26)

(ORNL-3544) OTS: $0.50

The excessive loss of uranium incurred when discarding magnesium fluoride, (the adsorber used to selectively remove technetium hexafluoride from uranium hexafluoride streams) is a problem common to all volatility processes for recovering enriched uranium fuels. As a result of the work described, two schemes for the release of the uranium hexafluoride from the

magnesium fluoride and its separation from the technetium hexafluoride are proposed. One scheme depends on preferential thermal desorption of the uranium hexafluoride at 350° C, and the other depends on selective adsorption of the uranium hexafluoride on sodium fluoride pellets following the codesorption of the two hexafluorides with fluorine at 500° C from the magnesium fluoride pellets. These proposals are aimed at reducing the amount of retained uranium to less than 1 g per 1000 g of discardable magnesium fluoride. Author

**N64-14912*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**NEAR-ULTRAVIOLET, VISIBLE, AND INFRARED SPECTRA OF MOLTEN KSCN AND NaSCN**
Jacob Greenberg Repr. from J. Chem. Phys., v. 39, no. 11, 1 Dec. 1963 p 3158–3159

The near-ultraviolet, visible, and infrared absorptions of NaSCN and KSCN systems were measured in order to determine the sulfur species present. Spectra peaks were found for KSCN (in $\gamma$ $cm^{-1}$at 250° C) at 4000, 2740, 2020, 1721, 1385, 1272, 935, 743 and (at 400° C) at 4000, 2740, 2020, 1709, 1408, 1292, 935, and 738. Spectra peaks were found for NaSCN (in $\gamma$ $cm^{-1}$at 300° C) at 2762, 2020, 1718, 1406, 1255, 935, 745 and (at 400° C) at 2770, 2041, 1718, 1408, 1268, 930, and 741. An examination of the visible absorption spectra of sulfur vapor in the range of 300° to 700° C shows that the absorption of the $S_4$ species is almost identical to that of the blue sulfur species present in sodium and potassium thiocyanate melts. This plus the fact that $S_8$ absorbs in the ultraviolet and $S_6$ and $S_2$ are known to be yellow indicates that the species present in the fused salts is $S_4$. P.V.E.

**N64-14926** Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
**CHEMICAL PROCESSING TECHNOLOGY Quarterly Progress Report, Apr.–Jun. 1963**
J. R. Huffman, J. A. Mc Bride, and J. R. Bower AEC National Reactor Testing Station, 15 Jan. 1964 44 p refs
(Contract AT(10-1)-205)
(IDO-14621) OTS: $1.00

This article is concerned with progress in chemical processing technology and includes discussions in the following areas: operational schedule, performance, and problems; aqueous process studies—aqueous zirconium fuel processing and tributyl phosphate degradation studies; electrolytic dissolution systems—pilot plant studies; new waste treatment methods; waste calcination; and plant improvements. C.L.W.

**N64-14956** Bureau of Mines, Berkeley, Calif. Thermodynamics Lab.
**HEAT AND FREE ENERGY OF FORMATION OF MUSCOVITE**
Ronald Barany 1964 10 p refs
(BM-RI-6356)

The heat of formation at 298.15° K of muscovite was determined by solution calorimetry. The value obtained for the heat of formation from the elements was $-1,421.2 \pm 1.3$ kcal/mole, and the value for the heat of formation from the oxides was $-55.9 \pm 1.3$ kcal/mole. Author

**N64-14965** United Aircraft Corp., East Hartford, Conn.
**EXPERIMENTAL EVALUATION OF THE HEATS OF FORMATION OF B-H-C-N COMPOUNDS Quarterly Technical Summary Report No. 2, 16 Sep.–15 Dec. 1963**
J. D. Rockenfeller Jan. 1964 12 p refs
(Contract NOw 63-0750-d; ARPA Order 419)
(UACRL B910078-2; AD-428587)

This report contains a tabulation of the calibration data for the calorimetric system and a discussion of the preliminary data for the heat of formation of the compound hydrazine monoborane (HMB). These latter data lead to a preliminary value of $-7.5 \pm 2.0$ kcal/mole for the heat of formation of HMB. Author

**N64-14969** Battelle Memorial Inst., Columbus, Ohio
**DEVELOPMENT OF ANALYTICAL TECHNIQUES FOR THE DETERMINATION OF MINUTE QUANTITIES OF SELECTED ELEMENTS IN BERYLLIUM Final Report, 6 Jun. 1962–6 Jun. 1963**
W. M. Henry 22 Jul. 1963 48 p
(Contract NOw 62-0629-c)
(AD-410234)

Development efforts were carried out on vacuum-spark mass spectrography, on activation oxygen analysis, and, to a lesser extent, on vacuum-fusion analysis emission spectrography, chemical nitrogen analysis, and conductometric carbon analysis methods. The results of the efforts, together with analytical data and complete descriptions of the experimental work, are given. Problems of high blanks on carbon and hydrogen and insufficient standardization on oxygen and nitrogen make mass spectrography supplemented by gasometric and chemical methods for carbon, hydrogen, and possibly nitrogen and oxygen the most useful method for determining total minute traces of impurities in beryllium presently. Resistivity measurements provide a rapid, economical method of evaluating the overall purity of beryllium. Author

**N64-14988** Bureau of Mines, Boulder City, Nev.
**METHODS FOR PRODUCING TITANIUM LOWER CHLORIDES**
V. E. Homme and M. M. Wong 1964 20 p refs
(BM-RI-6360)

Tests were made in reactors ranging from 12 to 30 in. in diameter to develop methods for the preparation of sodium chloride–titanium lower chloride (dichloride and trichloride) melts that contain titanium predominantly in the divalent state. Such melts are desirable as a starting material for the production of titanium metal or as an electrolyte for electrorefining of titanium. Sodium reduction of $TiCl_4$, with an 18-hr period of holding the reaction products in the molten state, produced melts that contained titanium lower chlorides in $TiCl_2$-to-$TiCl_3$ molar ratio of approximately 8 to 1. Sodium reduction of $TiCl_4$ in a reactor with a shielded pipe weir, which required no melt-holding period, produced melts with a $TiCl_2$-to-$TiCl_3$ molar ratio as low as 4 to 1. Reduction of $TiCl_4$ with scrap titanium metal in molten sodium chloride produced relatively pure melts containing about 27-percent titanium in a $TiCl_2$-to-$TiCl_3$ molar ratio of approximately 4 to 1. Author

# 08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

**N64-14301** Sparton Corp., Jackson, Mich.
**THE ENVIRONMENTAL METEOROLOGICAL DATA SYSTEM Final Engineering Report**

Patrick AFB, Fla., AF Missile Test Center. 2 Oct. 1963 47 p
(Contract AF 08(606)-5719)
(MTC-TDR-63-8; AD-291902)

A superheterodyne receiver is designed which consists of a preselector, a radiofrequency amplifier, an oscillator, a mixer, four IF stages, a detector audio amplifier, and an audio output amplifier. The system meets or exceeds the requirements of the specification in all areas of investigation, with the exception of the weight and the selectivity at the db points. C.L.W.

**N64-14311** Rome Air Development Center, Griffiss AFB, N.Y.
**DEVELOPMENT OF RADOME CW-424/FPS-26**
Charles S. Beal Dec. 1963 50 p refs
(RADC-TDR-63-481; AD-427842)

The structural and electrical parameters are discussed from a theoretical and then from a practical approach. An optimum rigid C-band radome was attained. The design computations have been greatly abbreviated as the standard detail analyses are identical with those shown in the references. Similarly, no actual antenna patterns are shown. The required data are summarized in the enclosed tables. Author

**N64-14344** Aerospace Corp., El Segundo, Calif. Materials Science Lab.
**POWER REQUIRED TO JAM A SATELLITE REPEATER**
F. F. Yates Dec. 1963 18 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-203; TDR-269(4111)-3; AD-428375) OTS: $1.60

A general expression is derived for the ratio of interference power to signal power required at the terminals of the receiving antenna of a communication satellite (in the bandpass of a communication channel) to reduce the performance of the channel to any specified minimum condition. The expression may be applied to the analysis of spread-spectrum multiple access systems as well as to the analysis of jamming vulnerability Author

**N64-14509** Raytheon Co., Bedford, Mass. Space and Information Systems Div.
**INVESTIGATION OF ACTIVE DOPPLER VELOCITY SENSOR Final Report Jun. 1962-Oct. 1963**
James C. Rand et al 1 Oct. 1963 86 p refs
(Contract AF 33(657)-9241)
(BR-2604; RTD-TDR-63-4192; AD-426754)

The spectral compression technique was the principal subject of investigation, and effort was divided into the following areas: (1) development of a wide frequency deviation, highly linear, low noise, microwave, FM/CW transmitter;(2) development of a computer and control unit capable of automatic modulation slope control and Doppler frequency computation; (3) flight testing of the developed equipment; and (4) theoretical analysis in support of equipment development and of subjects relating to the physics of spectral compression. The investigation of spectral compression culminated in the successful flight demonstration of the technique in a B-26 aircraft. Spectral analysis showed that a direct increase in peak spectral density accompanied the bandwidth reduction. Compression ratios of 10:1 were achieved when viewed over the period of one second, and even greater ratios (20 to 30:1) were achieved over several modulation periods. Author

**N64-14641** Electronics Research and Development Lab., Fort Monmouth, N.J.
**DEVELOPMENT OF S-BAND FERRITE DUPLEXER**
Maurice Weiner Jul. 1963 17 p refs
(USAELRDL-TR-2390; AD-422334)

This report discusses the development of an S-band ferrite duplexer being designed for operation at 750 kw of peak power and 750 w of average power. With this as a goal, an S-band ferrite circulator and limiter combination is considered. The circulator is a four-port phase-shifting type. The limiter consists of two parallel strip-line waveguides coupled together by two yttrium-iron-garnet (YIG) spheres. Experimental results are presented for power levels up to 550 kw. Typical insertion losses from transmitter-to-antenna and from antenna-to-receiver are 0.4 and 1.5 db, respectively. The successful development of this device will overcome the deficiencies of the limited life capability of the gas-discharge duplexer and the limited power-handling capability of the semiconductor power limiter. Author

**N64-14796** National Bureau of Standards, Boulder, Colo.
**EQUIPMENT CHARACTERISTICS AND THEIR RELATION TO SYSTEM PERFORMANCE FOR TROPOSPHERIC COMMUNICATION CIRCUITS**
A. F. Barghausen, F. O. Guiraud, R. E. Mc Gavin, S. Murahata, and R.W. Wilber 16 Jan. 1963 81 p refs
(NBS-TN-103; ESD-TDR-63-315; AD-400925) GPO: $1.00

This report considers the aspects of the equipment which affect the performance of a tropospheric circuit. In general, tropospheric circuits can be divided into two types: (1) those which are concerned with the propagation of radio energy to a point far beyond the radio line of sight, and (2) those in which propagation is over relatively short distances where the receiving terminal is within the radio line of sight of the transmitting terminal. The same principles generally apply whether beyond line of sight or within line of sight is considered. The requirements and tolerances recommended are more stringent for long paths, whereas some latitude may be allowed for the shorter path. Author

**N64-14890*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**ASTRONAUTICS INFORMATION: TELEVISION, PHOTOGRAMMETRY, PHOTOMETRY, AND RADIOMETRY ADAPTABLE TO SPACE RECONNAISSANCE**
Judith Hayes, comp. Nov. 1963 308 p 2026 refs
(NASA Contract NAS7-100)
(NASA CR-53045; JPLAI/LS 490) OTS: $19.75 ph, $9.74 mf

This literature survey covers the following sources: Astronautics Information Abstracts, Astronautics Information Survey, Astronomischer Jahresbericht, Applied Science and Technology Index, Electrical Engineering Abstracts, Engineering Index, Physics Abstracts, Defense Documentation Center, JPL IBM Subject Listing, JPL Book File, and Publishers Guide to Books in Print. The time period covered is from 1959 to 1963. An author index and a corporate source index are included. R.L.K.

**N64-14900*** Electromagnetic Research Corp., College Park, Md.
**SPACE CHARGE CREATED BY AN ANTENNA IN AN IONIZED MEDIUM Memorandum Report**
Martin Katzin 31 May 1962 5 p
(NASA Contract NAS5-585)
(NASA CR-55334; NAS-585-4) OTS: $1.10 ph, $0.80 mf

The effect of the nonlinear motion of the oscillation of electrons with a radial component of vibration on the resulting distribution of ionization in the vicinity of the antenna is investigated. The procedure used is essentially a perturbation analysis, since it is assumed that the electric field due to the RF voltage applied to the antenna varies as $1/r$, where $r$ is the distance from the antenna axis. Consequently, the results obtained should be considered as a first approximation to the actual state of affairs. The analytical procedure begins with the differential equation obeyed by the radial component of electron motion: $m\ddot{r} = eE_r = eE_0/r \cos\omega t$ where $E_0$ is the radial electric field at unit radial distance and e is the charge of an electron. Results of the analysis are: (1) A positive ion sheath is produced around the antenna, its thickness being $d = |\alpha|/R_0 = |e|E/m\omega^2 R_0$. (2) The antenna collects a negative charge per unit length given by $Q_0 = \pi e E_0 E_0^2/m\omega^2 R_0^2 = -\pi\epsilon_0 E_0 d/R_0$. (3) The electron density exceeds the ion density in the region outside the ion sheath by an amount $\delta N = \epsilon_0 E_0^2/m\omega^2 r^4$. In the above equations $R_0$ is the antenna radius, $\alpha$ is the distance, and E is the electric field. I.v.L.

**N64-14910** Collins Radio Co., Dallas, Tex.
**STUDY OF ATCRBS DATA TRANSFER OVER EXISTING RML EQUIPMENT Final Report**
A. B. Crumpton and D. O. Duncan Jul. 1963 131 p
(Contract ARDS-631)
(CER-D1695)

A test system consisting of RML-4 terminal and repeater equipment was assembled and evaluated. The test methods, equipment used, and the acquired data are contained in this report. Detailed beacon video-channel performance data are presented with particular emphasis on the performance characteristics when the system is loaded with pulse trains corresponding to 4096 Beacon Codes. These tests were made under simulated conditions such that the acquired data would represent practical system performance rather than performance in a laboratory environment. A brief investigation was also performed to evaluate the system video performance as a function of microwave frequency drift. Author

**N64-14937*** Electronic Communications, Inc., Timonium, Md.
**TECHNIQUES FOR SUPERHETERODYNE RECEIVERS ABOVE 100 GIGACYCLES**
R. F. Packard, ed. Washington, NASA, Feb. 1964 68 p refs
(NASA Contract NASw-259)
(NASA CR-2) OTS: $1.75

Techniques are described that are applicable to millimeter-wave superheterodyne receivers of the harmonic-mixing broad intermediate-frequency-band type for use as radiometers. Methods are given for assembling point-contact semiconductor diodes in millimeter waveguides. The progress is reported of a statistically designed experiment to evaluate various whisker and semiconductor materials for use in harmonic generators and mixers. A novel bolometer of ferroelectric material for absolute power measurements at millimeter wavelengths is described, and progress in development is reported. Experimental results with ferrite Faraday rotators at 2 and 4 mm are given. Design of thermal calibrators for radiometers is discussed. Open resonator techniques are reviewed, and antennas for millimeter radiometers are compared. Author

**N64-14980** Radiation Inc., Melbourne, Fla.
**INTERFERENCE MONITOR FEASIBILITY STUDY, PHASE III Final Report**
Louis F. Moses, John L. Elberson, G. Duggan, W. F. Quinlivan, and K. M. Wooded Sep. 1963 75 p
(Contract AF 30(602)-2695)
(Rept. 1593-3; RADC-TDR-63-406; AD-427080)

The objective of this program is to define the problems in monitoring the spectrum from 200 Mc to 40 Gc and to investigate possible technical approaches to implement a solution. To meet these objectives a breadboard monitor, operating from 2 Gc to 4 Gc, has been constructed and utilized to demonstrate the feasibility of the recommended monitor technique. This report covers the design completion of the feasibility breadboard model and contains a synthesis of recorded results of RFI testing in both the laboratory and the field. Author

# 09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

**N64-14286*** Westinghouse Electric Corp., Baltimore, Md. Electronics Div.
**TRANSOR DECISION FUNCTIONS AND STATISTICAL MEASUREMENT OF QUALITY Special Technical Report No. 4**
R. S. Bray, P. A. Jensen, and C. G. Masters Sep. 1963 50 p refs
(NASA Contract NASw-572)
(NASA CR-55307) OTS: $4.60 ph, $1.70 mf

The Transor class decision function is described as it might be used in a multiple-line restoring circuit application. Mathematical reliability models are derived that describe the Transor operation in different failure environments. Procedures are discussed that are being developed to aid in determining the ability of a redundant system to perform a mission of stated duration. It is proposed that the system be tested at the beginning of the mission to gain information on the number and location of failed circuits in the system and the failure rates of the system's circuits. Several techniques are presented that show how to use this data to estimate the mission reliability; this estimate will be a basis for determining the acceptability of the system. One technique is presented that judges the acceptability of the system without a reliability estimate. Author

**N64-14293** Radio Corp. of America, Harrison, N.J.
**AN L-BAND TUNNEL DIODE OSCILLATOR Fifth Quarterly Progress Report, 1 Jun.-31 Aug. 1963**
D. E. Nelson, R. Gold and E. T. Casterline [31 Aug. 1963] 30 p refs
(Contract D-36-039 SC-90773)
(AD-427609)

A study was made of the effect of diode peak current on diode speed index and cutoff frequency. The effect of different crystalline planes on diode current density (hence high frequency capability) was also investigated. A simple transistor regulator for tunnel-diode oscillators was devised. This regulator reduced the frequency variation, due to a ±10% variation in bias voltage, from over 100 mcs to less than 4 mc. Two tunable tunnel-diode oscillators were tested that gave minimum power outputs of 19 and 22 mw, respectively, over the

required 1660 to 1700 mc tuning ranges. Both incorporated transistor regulators and easily met the required ±2 mc maximum frequency variation for a ±10% change in bias voltage. One oscillator was delivered as a prototype model, and the second is ready for delivery. Author

**N64-14297** Microwave Electronics Corp., Palo Alto, Calif.
**ONE-WATT CW S-BAND TRAVELING-WAVE TUBE WITH 6 DB NOISE FIGURE**
Henry Friedman Griffiss AFB, N.Y., Res. and Technol. Div., Dec. 1963 19 p
(Contract AF 30(602)-3025)
(RADC-TDR-63-462; AD-428056)

Several diodes have been built employing active cathodes and have exhibited very encouraging data. Current densities on the order of 1.5 amps/cm$^2$ (CW) have been obtained at normal operating temperatures (700° C). Revised techniques for processing tubes with active cathodes have been instituted. Four vacuum envelope assemblies were fabricated. Two assemblies developed vacuum leaks at the pin seal. The third assembly developed a vacuum leak at the tube "pinch-off" after removal from the exhaust station. RF data were taken on the fourth tube, which exhibited a minimum noise figure of 5.3 db (uncorrected) at 2.8 Gc at 5 ma cathode current. The saturated power output at 4 ma was 200 mw. Author

**N64-14327** Technical Research Group, Inc., Menlo Park, Calif.
**AN INVESTIGATION OF THE HF WIRE-GRID LENS ANTENNA FOR DIRECTION FINDING Final Report**
R. L. Tanner, M. G. Andreasen, E. D. Sharp, and J. C. Greene Griffiss AFB, N.Y., RADC, Dec. 1963 201p refs
(Contract AF 30(602)-2742)
(RADC-TDR-63-211; AD-427720)

An electromagnetic solution of the radiation characteristics of the HF wire-grid lens antenna is outlined. This electromagnetic solution yields accurate radiation patterns for lenses having any diameter-to-wavelength ratio. This solution also includes the effect on the radiation pattern of the flared horn surrounding an actual wire-grid lens, both for the case in which the horn surfaces are constructed of isotropic metal conductors, and for the case in which the horn surfaces are constructed from radial wires. The validity of the lens solution has been tested against results obtained by H. Jasik for the special case of a Luneburg lens. Author

**N64-14336** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**EVALUATION OF NOISE IMMUNITY OF AUTOMATIC PULSE RADIO RANGE FINDER UNDER SEARCH CONDITIONS**
M. P. Bobnev 12 Sep. 1963 12 p refs Transl. into ENGLISH from Radiotekhnika (Moscow), v. 18, no. 5, 1963 p 59-65
(FTD-TT-63-776/1+2; AD-422871)

The article discusses the action of disturbances on a typical radio range finder operating under conditions of searching for a useful signal. Numerical relationships are derived that enable the evaluation of the immunity to interference of a range finder operating under search conditions and the selection of the basic parameters of its system. Author

**N64-14352** Sylvania Electric Products Inc., Mountain View, Calif. Microwave Device Div.
**OPTIMIZED COHERENT OPTICAL RECEIVER TECHNIQUES**
Robert Ogrodnik Griffiss AFB, N.Y., RADC, Tech. Branch Dec. 1963 27 p refs
(Contract AF 30(602)-3162)
(RADC-TDR-63-490; AD-428379) OTS: $2.60

The initial tube design has been completed, utilizing an image dissector electron gun, together with an X-band slow-wave structure. The construction of test diodes to evaluate the cathode surface has been completed. The evaluation of the deflection system using a complete gun tester, but without a slow-wave structure, has begun. One gun tester has been completed, and the deflection system is finished except for the sweep amplifiers. Author

**N64-14353** Army Missile Command, Huntsville, Ala. Electromagnetics Lab.
**AN INVESTIGATION OF MICROWAVE BROADBAND TRANSISTOR AMPLIFIERS**
S. T. Uptain and R. D. Thompson 30 Jul. 1963 15 p refs
(RE-TM-63-4; AD-428378) OTS: $1.60

This report summarizes the procedures and results of a study made of transistor amplifiers for possible use in phased-array radar applications. Various commercially available types of transistors were investigated, with particular emphasis on their gain-bandwidth product and noise figure. Using the most promising of these as a basis, a method was devised for designing the optimum circuit. This method, employing a Linvill chart, is described in the report. Author

**N64-14355** Maryland U., College Park
**PRESSURIZED TRIGATRONS WITH A 10 KV-50 KV LOW JITTER OPERATING RANGE**
George Goldenbaum and Eduard Hintz Jul. 1963 24 p refs
(Sponsored by ONR, AF Geophys. Res. Directorate, and NSF)
(AD-428398; Tech. Rept. 314) OTS: $2.60

By using enclosed switches at higher pressures and smaller electrode spacing, the breakdown characteristics of asymmetric trigatrons have been further improved. The mechanical construction remains simple, and voltages up to 50 kv can be switched. At electrode distances from 3 mm to 5 mm and at pressures between 15 and 75 psi both statistical and formative time lags are below 20 mμsec, even with the operating voltage as low as one-third of the static breakdown voltage. The comparatively small breakdown voltage in the triggered case with the observed short delay times is caused by the increasing nonuniformity of the electric field when the trigger potential is raised, and by an intermittent corona between the trigger pin and the main electrode which starts during the charging period. Author

**N64-14365** Aerospace Research Labs., Wright-Patterson AFB, Ohio Plasma Physics Research Lab.
**RELIABLE SPARK GAP FOR CAPACITOR BANK SWITCHING**
W. D. Bunting, Jr. Nov. 1963 20 p refs
(ARL-63-219; AD-427754)

Holdoff reliability, switching time, and jitter are measured for a newly designed spark-gap switch to be used in a 3-kilojoule capacitor bank. Time study photographs of the breakdown are used to explain the existence of two distinct modes of switch operation depending upon a critical value of the working voltage. Author

**N64-14368** RCA Victor Co., Ltd., Montreal (Canada) Research Labs.
**ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF THE PRESENCE OF IONIZED MEDIA ON ANTENNA PROPERTIES Final Report**
M. P. Bachynski Oct. 1963 118 p refs
(Contract AF 19(604)-7334)
(AFCRL-63-541; AD-427397)

An experimental investigation of the behavior of a microwave horn antenna in the presence of a plasma sheath generated in helium has been conducted at a frequency of 9.7 Gc (x-band). A comprehensive series of investigations designed to test the validity of various theoretical treatments of plasma properties and to assess the accuracy of various microwave systems for determining the properties of plasmas that are finite in extent using free-space microwave techniques have been performed. Theoretical results have been obtained for prediction of plasma effects such as plasma boundaries, refractive defocusing, nonuniformity of plasma, and diffraction due to finite size of the plasma. Preliminary considerations have been given to the investigation of antenna properties in the presence of a plasma sheath that is anisotropic due to the presence of a static magnetic field. Author

**N64-14371** Watkins-Johnson Co., Palo Alto, Calif.
**WIDE BAND ELECTRONICALLY TUNABLE FILTERS Technical Note No. 4**
A. W. Shaw Griffiss AFB, N.Y., Rome Air Develop. Center, Oct. 1963 15 p ref
(Contract AF 30(602)-2625)
(W-J-63-609R20; RADC-TDR-63-515; AD-426111) OTS: $1.60

Progress on YIG nonreciprocal filters at 1 to 18 Gc is discussed. Most of the effort has been with the construction and testing of units for delivery. Little design remains to be done. Problems associated with the construction and adjustment of the various filters are discussed. Author

**N64-14382** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**ELECTROACOUSTICAL TEMPERATURE-FREQUENCY CONVERTER**
V. V. Kovalevskaya and V. K. Potapkin 8 Oct. 1963 9 p refs
Transl. into ENGLISH from Priborostroenie (Moscow), no. 2, 1963 p.11–13
(FTD-MT-63-99/1+2+3+4; AD-428553) OTS: $1.10

A device is described that uses the method of temperature-frequency conversion based on the phenomenon of acoustic resonance. This electroacoustic temperature converter consists of an acoustic resonator (constituting a sensing element), a microphone and a telephone for converting sound oscillations into electric pulses and vice versa, and an amplifier. The design of the converter is simple. It has a high reliability; however, there is a shortcoming in its significant thermal constant. C.L.W.

**N64-14481** New York U., N.Y. Research Div.
**STATUS REPORT ON PROJECTS DEALING WITH ADVANCED ELECTRON DEVICE TECHNOLOGY**
Washington, D.C., Defense Dept., Oct. 1963 62 p refs
(Contract DA-36-039sc-89076)
(Rept. 77; AD-428794) OTS: $5.60

Abstracts are presented of various microwave, low power, high power, special (camera tubes, etc.), and passive devices. In addition, abstracts are presented of device rating, reliability, life and environment studies of various microwave, low power, and passive devices as well as of device techniques and studies of related phenomena regarding microwave, low power, high power, special (displays, electron-gun fabrication, etc.), passive, and laser devices. I.v.L.

**N64-14483** Polytechnic Inst. of Brooklyn, N.Y.
**RADIATION FROM A DIRECTIVE ANTENNA EMBEDDED IN AN ANISOTROPIC HALF SPACE Scientific Report No. 1**
L. B. Felsen and B. Rulf 9 Aug. 1963 35 p refs
(Contract AF 19(628)-2357)
(PIBMRI-1183-63; AFCRL-63-512; AD-425691)

Analysis has confirmed the following: If the major lobe of a directive antenna is being scanned through the complete range of angles of propagation (measured from the positive z-axis), an observer in the shadow region sees a sharply increased field response $\theta = \hat{\theta}$ (angle of total reflection). Two critical angles $\hat{\theta}_{1,2}$ exist, each of which is associated with its own lateral wave. By pointing the major lobe of the antenna along one or the other of these directions, it is possible to verify the validity of the rather unconventional lateral wave trajectories that were found in a previous study. These lateral wave aspects were the primary object of the present investigation involving a directive source distribution inside a uniaxially anisotropic plasma half-space. The properties of the direct, reflected, and refracted beams were also studied, and it was found that they can be predicted from the point source results. The radiation pattern of a finite antenna in an anisotropic medium is equal to the pattern of a point source multiplied by the array factor. The major features of the radiation pattern are found to be predictable from a study of the refractive index curves, and the quantitative field description can be obtained by combining these plane wave considerations with the known radiation formulas for a point source. R.T.K.

**N64-14489** Harry Diamond Labs., Washington, D.C.
**20-VOLT AVALANCHE DIODES AS NOISE GENERATORS**
K. O. Otley 5 Nov. 1963 24 p refs
(TR-1184)

Measurements of noise output and observations of noise spectra were made on 20-v silicon avalanche diodes (often called Zener diodes) over the range of noise-producing voltage at −40°, 75°, and 160° F. Among those tested, type−N1317A is believed most suitable for use as a noise generator, but planar diodes are preferred in all circuits in which a sufficiently high supply voltage is available. Author

**N64-14491** Illinois U., Urbana Digital Computer Lab.
**TUNNEL DIODE CIRCUITS COUPLED INTO TRANSMISSION LINES**
Tohru Moto-Oka 16 Aug. 1963 45 p
(Contract Nonr-1834(15))
(ONR-155; AD-427731)

All interconnecting wires should be considered as transmission lines in very high speed circuitry. There are two groups of methods which are used in the design of very high speed tunnel-diode switching and logic circuits. In the first method it is assumed that all constants are ideal lumped constants and that they are interconnected ideally at first. They are then replaced by distributed circuitry. In the second method tunnel diodes are connected to distributed circuitry from the beginning. The character of the tunnel-diode circuits coupled into distributed circuits is not understood well enough to design very high speed switching and logic circuits. In this report, typical tunnel-diode circuits coupled into transmission lines are investigated as the preparatory stage of latter design methods. Author

**N64-14496** Michigan U., Ann Arbor
**INVESTIGATION OF LARGE-SIGNAL TRAVELING-WAVE TUBES Quarterly Progress Report No. 5**
G. T. Konrad and J. E. Rowe Griffiss AFB, N.Y., Tech. Branch, Dec. 1963 71 p
(Contract AF 30(602)-2834)
(RADC-TDR-63-519; AD-428198)

Extensions on the two-dimensional large-signal analysis for klystrons and traveling-wave tubes are presented. Space-charge effects and the effects of stream subdivisions and the number of charge groups chosen are shown in a number of graphs. Work on the nonlinear theory of multistream microwave devices by a density function method is summarized. An improved method of handling the coupling between positive and negative velocity regions has been worked out. Experimental test results on several phase-focused tubes are presented. Efficiency enhancements obtained by this method as well as a simple depressed potential collector are described. Several minor changes made on the solid beam digital computer program are described. The status of the program for solution of magnetron injection guns is discussed. Author

**N64-14499** Harry Diamond Labs., Washington, D.C.
**THE APPLICATION OF PULSE SEQUENTIAL CIRCUITRY TO CONTROL DEVICES**
Ira R. Marcus 20 Nov. 1963 19 p refs
(TR-1185; AD-425879)

This report describes the application of pulse sequential circuitry theory to the design of an all-solid-state electronic control circuit. In pulse sequential circuits, an output program occurs only upon receiving a unique input sequence. A prototype model was built, and its performance was satisfactory. Author

**N64-14502** Georgia Inst. of Tech., Atlanta
**STUDY AND DEVELOPMENT OF HIGH TEMPERATURE (300°C) FREQUENCY CONTROL Final Report, 1 Jul. 1961-1 Jan. 1963**
R. B. Belser, W. E. Woolf, and L. L. Folsom Wright-Patterson AFB, Ohio, AF Avionics Lab., Jul. 1963 111 p refs
(Contract AF 33(616)-8398)
(ASD-TDR-63-398; AD-407516)

Literature or experimental investigations of possible oscillator devices of high stability over the temperature range −55° to 300° C have been made. AT-cut quartz resonators of 10 mc frequency operated satisfactorily throughout the temperature range, but the minimum frequency deviations observed were ± 730 ppm over the range −55° to 300° C (angle of cut, $\theta$ = 36° 42') and ± 665 ppm over the range 0° to 300° C ($\theta$ = 36° 48'). By summing the frequencies of 10 mc AC-cut and 12 mc BC-cut quartz resonators, of opposite temperature coefficients of frequency change, the deviation was reduced to ± 185 ppm over the range −55° to 300° C and ± 80 ppm over the range 25° to 300° C. Angles of cut for AC and BC units, respectively, were 30° 45' and 60° 00' for the former pair and 31° 45' and 56° 00' for the latter pair. Swept cultured quartz resonators exhibited lower $R_s$ changes over the temperature range than natural quartz and therefore maintained a higher Q. Author

**N64-14504** Rensselaer Polytechnic Inst., N.Y.
**INVESTIGATION OF TRANSIENT RADIATION DAMAGE IN SEMICONDUCTOR MATERIALS First Quarterly Progress Report, 1 Feb.-30 Apr. 1963**
Roland M. Lichtenstein [1963] 12 p
(Contract DA-36-039-AMC-02165(E))
(AD-420958)

Initial estimates of the transient radiation damage effects show that small signals that are preceded by very large signals have to be measured. Electronic equipment adequate to this task had to be designed and tested. The outcome was a battery operated amplifier with three long-tailed pairs and a cascode cathode follower output stage. Author

**N64-14527** Joint Publications Research Service, Washington, D.C.
**INVESTIGATION OF ONE MODEL OF A NEURISTOR**
G. N. Berestovskiy 3 Feb. 1964 16 p refs Transl. into ENGLISH of an article from Radiotekh. Elektron. (Moscow), v. 8, no. 11, 1963 p 1862-1871
(JPRS-23046; OTS-64-21469) OTS: $0.50

This report describes an electrical model of a neuristor which consists mainly of: (1) a source of energy; (2) a storage element for energy; and (3) a nonlinear discharging device (a discharging resistor) that assures the regenerative character of the process of pulse formation. The properties of this discharging resistor are discussed in detail. I.v.L.

**N64-14621** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**CIRCUITS WITH DIRECT COUPLING**
L. V. Kutukov and D. I. Obidin 27 Sep. 1963 37 p refs Transl. into ENGLISH from book "Elektronnyye Vychislitel'nyye Mashiny" Moscow, 1962 p 1-39
(FTD-TT-62-1869/1+2; AD-428628)

Topics of discussion include: (1) operation of transistors in switching modes in the range of heavy saturation; (2) specific character of the functioning of direct coupled circuits; (3) condition for the stability of direct coupled circuits; and (4) influence of temperature on the functioning of direct coupled circuits. Experimental results and conclusions are included. J.E.T.

**N64-14630** Daystrom, Inc., Newark, N.J. Weston Instruments and Electronics Div.
**CHEMICAL FORMATION OF MICROCIRCUIT ELEMENTS Technical Report, 28 Jan.-27 Sep. 1963**
T. K. Lakshmanan, C. A. Wysocki, and J. M. Mitchell Griffiss AFB, N.Y., RADC, Dec. 1963 59 p refs
(Contract AF 30(602)-2971)
(RADC-TDR-63-491; AD-428590)

A sputtering technique for the preparation of dielectric films of titanium oxide is described. Uniformity, reproducibility, and stability during the period of test have been established. Capacitance values are about 0.4 $\mu F/cm^2$. Frequency dependence and temperature coefficient of capacitance and dissipation are given. Curves showing long-term stability of resistive films are included. The feasibility of using this technique for developing titanium resistors and capacitors is demonstrated. Author

**N64-14633** Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
**COMPATIBLE TECHNIQUES FOR INTEGRATED CIRCUITRY Ninth Quarterly Progress Report, 1 May-31 Jul. 1963**
[1963] 119 p refs
(Contract AF 33(616)8276)
(AD-426051)

The current status of the following areas is discussed: (1) compatible thin-film techniques as applied to resistors and capacitors; (2) silicon integrated circuit technology; (3) parasitic effects in integrated circuits, such as capacitance and transistor action; (4) the fabrication of the compatible RF amplifier; (5) VHF transreceiver circuit design and evaluation, and (6) the construction of the digital communications system. I.v.L.

**N64-14634** Litton Industries, San Carlos, Calif. Research Lab.
**HIGH PERVEANCE GUN STUDY Ninth Quarterly Progress Report, 1 Jun.-31 Aug. 1963**
R. D. Harris and F. F. Lee 13 Sep. 1963 20 p refs
(Contract DA-36-039-SC-87313)
(AD-428445)

Design objectives for an L-band superpower amplifier klystron, utilizing a high-perveance hollow beam, are presented. The tube will be constructed so that RF characteristics of the hollow beam can be examined for beam perveances ranging from 10 $\mu a/v^{3/2}$ to 20 $\mu a/v^{3/2}$. The electrical design of a magnetron injection gun is reported. The gun will utilize an inverted geometry (cathode diameter greater than modulating anode) in a tapering magnetic field. The operating perveance will be 20 $\mu a/v^{3/2}$, and the gun will have a convergence in area of 19. The klystron body is being scaled from an existing L-band tube. The electrical design of the RF structure, including broadbanding techniques to conform to the new design objectives, is presented. Author

**N64-14636** Raytheon Co., Lewiston, Me. Semiconductor Div.
**PRODUCTION ENGINEERING MEASURE ON SILICON ALLOY TRANSISTORS Quarterly Report No. 5, 1 Jul-30 Sep. 1963**
R. W. Jones and A. W. Postlethwaite [1963] 31 p refs
(Contract DA-36-039-SC-86744)
(AD-428089)

Centering of the silicon resistivity specification is described with parameter distributions. Introduction of X-ray orientation, ID slicing, and variably indexed scribing is discussed. A modified rinsing tank with electrolytic monitoring was introduced into production. The feasibility of the use of a thermographic phosphor to monitor burn-in racks was demonstrated as a reliable production technique. Power step-stress was used to monitor the improvement of production product. Author

**N64-14651** Army Missile Command, Huntsville, Ala. Electromagnetics Lab.
**IMPROVED MICROWAVE PHASE MEASUREMENT TECHNIQUES**
Lloyd W. Root, Jr. 28 Jun. 1963 83 p refs
(RE-TR-63-35; AD-427847)

Phase stability is discussed showing the need for improved microwave phase measurement techniques. The state-of-the-art of microwave phase measurements is reviewed, and all known measurement techniques are discussed. The development of a precision, microwave, coax, moving short is discussed and experimentally evaluated. Phase detector techniques are discussed and evaluated. Conclusions include the best types of phase measurements for field, factory, and laboratory.
Author

**N64-14664** Sylvania Electric Products, Inc., Waltham, Mass.
**MULTIPLE BEAM INTERVAL SCANNER**
Francis J. La Russa 11 Sep. 1963 92 p refs
(Contract AF 19(604)-7385)
(AFCRL-63-535; SR-485-1; AD-428578)

An experimental program to demonstrate the feasibility of combining a coaxial probe monopulse organ pipe scanner with a wide-angle two-dimensional "constrained" lens is described. The antenna system that was built and tested to prove this feasibility operates in the 5.250 to 5.750 mcs range. It produces a half-power beamwidth of 2 degrees in azimuth by 4 degrees in elevation, which can be scanned ±36 degrees from broadside in the azimuth plane. Variations of the measured radiation characteristics with frequency and angle of scan are summarized in graphical form. Design data and typical monopulse sum and difference patterns are presented. The test results show that such a lens-scanner antenna system is practicable for wide-angle scanning in one plane. Author

**N64-14683** Colorado U., Boulder
**THEORETICAL CALCULATIONS OF THE IMPEDANCE OF A MONOPOLE ANTENNA WITH A RADIAL-WIRE GROUND SYSTEM ON AN IMPERFECTLY CONDUCTING HALF-SPACE Scientific Report No. 26**
S. W. Maley, R. J. King, and L. R. Branch 13 Dec. 1963 127 p refs
(Contract AF 19(604)-4556; Contract CST-7429)
(Rept. 8900-11-89422; AFCRL-63-583; AD-428156)

This report is a presentation of calculations, based on Wait's theory, showing the behavior of antenna impedance as a function of antenna height, top loading and number, size and length of radial wires, and ground conductivity and permittivity. Author

**N64-14692** American Meteorological Society, Boston, Mass.
**OSCILLOGRAPHIC INVESTIGATION OF ELECTRICAL WIRE EXPLOSIONS [OSTSILLOGRAFICHESKOE ISSLEDOVANIE ELEKTRICHESKOGO VZRYVA PROVOLOK]**
M. A. Mel'nikov and V. I. Obukhov Bedford, Mass., AFCRL, Aug. 1963 10 p refs Transl. into ENGLISH from Izvest. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 1, 1963 p 99-102
(Contract AF 19(604)-6113)
(AD-421985)

The electrical wire explosion in circuits with a varying internal resistance, $R_g$, including cases where the energy was supplied to the wire through a cable, was investigated. The explosion of a nichrome wire 0.1 mm in diameter and 30 mm long was studied. The storage capacitor was charged to a voltage of 23.2 kv; the capacity was 0.1 to 0.2 $\mu$f. The data indicate that the energy liberated in an electrically exploded wire and the rate of energy intake in an electrically exploded wire and the rate of energy intake increase with decreasing $R_g$ and $R_g/R(t)$, where R(t) is the resistance of the wire used in the experiments, and increasing storage-condenser capacity.
R.T.K.

**N64-14771** Washington U., Seattle Coll. of Engineering
**Final Report, March 15, 1958-March 14, 1963 [INVESTIGATION OF VARIOUS TYPES OF ANTENNAS LOCATED ON DIFFERENT GEOMETRIC STRUCTURES IN VARIOUS ENVIRONMENT]**
Akira Ishimaru Mar. 1963 28 p refs
(Contract AF 19(604)-4098)
(Tech. Rept. 81; AFCRL-63-509; AD-427760)

This report contains a brief description of research effort in each of the following areas: antenna pattern synthesis, modulated antennas, frequency scanning antennas, currents on a curved surface, periodic structures, and anisotropic media.
Author

**N64-14772** Motorola Inc., Phoenix, Ariz. Solid State Systems Div.
**MINIATURE THIN FILM INDUCTORS (MODIFICATION NO. 2) Second Interim Report, 1 Sep.-1 Dec. 1963**
F. R. Gleason 20 Dec. 1963 17 p
(Contract NObsr-85397)
(Rept. 4003-2; AD-426183)

Gold spiral coils of 0.67 and 1.58-μhenry air-core inductance have been fabricated on Ceramag 9 ferrite substrates. These coils were fabricated by electroplating a gold spiral pattern that was vacuum deposited on the substrate in two steps through two properly oriented masks. The methods used to solve the problems of adjacent turn shorting during electroplating and poor adhesion of the pattern to the substrate are described. Samples of the gold spirals have been encapsulated in ferrite film deposited at 800° C to thicknesses of 150μ. An inductance increase over air-core value of only 4 times was obtained, although the permeability of the films has been measured to be 70 or more. Author

**N64-14813** Directorate of Engineering Test, Aeronautical Systems Div., Wright-Patterson AFB, Ohio
**INVESTIGATION OF COMBINED-ENVIRONMENT TESTING FOR AIR FORCE EQUIPMENT**
Virgil J. Junker [1963] 47 p
(ASTEV-3-2; AD-429078) OTS: $4.60

The purpose of this effort was to determine whether combinations of natural and induced environmental conditions would produce debilitating or desirable effects that were different from those resulting from singly applied environmental tests. The program consisted of five phases: (1) an evaluation and analysis of standard single-environment test procedures, (2) the performance of "burn-in" and "base-line-reference" tests, (i.e., tests to determine performance data for comparison purposes), (3) the performance of natural and induced single-environment tests beyond design level to determine damage threshold, (4) the development of a test program consisting of tests that simulate combinations of those environments applicable to a selected test item, and (5) test trials to determine the effect of the combined-environment tests as compared to the effect of the single-environment tests. Data resulting from the combined-environment tests are limited to the specific item of Air Force electronic equipment tested. Author

**N64-14927** Industrial Science and Technology Agency, Tokyo (Japan) Electrotechnical Lab.
**TESTING METHOD AND CHARACTERISTIC OF SMALL SHOCK NOISE OF ELECTRON TUBE**
Hiroshi Shiomi Jun. 1962 51 p refs In JAPANESE; ENGLISH summary
(*Its* Researches 642)

A small shock impact apparatus for testing electron tubes by using a steel ball, and a method for calibrating the apparatus with an electron tube-type accelerometer are summarized. The noise of electron tubes, produced by this mechanical apparatus instead of manual tapping, shows a good reproducibility and gives further information about mechanical characteristics of the test piece. In spite of the complicated tube structure and its essential nonlinear mechanical characteristic against the shock, it is concluded that the response of electron tube to small shocks ($\alpha\tau_b$; 5 ≈ about 100 in G × m sec) and vibration may be approximately explained as the behavior of one or two freedom linear elastic system models. Author

**N64-14960** Rensselaer Polytechnic Inst., Troy, N.Y.
**INVESTIGATION OF TRANSIENT RADIATION DAMAGE IN SEMICONDUCTOR MATERIALS Second Quarterly Progress Report, 1 May-31 Jul. 1963**
6 Jan. 1964 6 p
(Contract DA-36-039-AMC-02165-(E))
(AD-428994)

The effect of X-ray flashes (produced by the Linac) on small silicon samples was examined. The amplifier and associated shielded cables performed as expected. Coincident with the X-ray flash, the electrical conductance of the silicon sample increased suddenly and then returned to its normal value with a relaxation time of about five microseconds. Author

**N64-14991** University of Southern Calif., Los Angeles Engineering Center
**ON THE DIELECTRIC COATED PROLATE SPHEROIDAL ANTENNA**
Cavour W. H. Yeh Jun. 1962 24 p refs
(Contract AF 19(604)-6195)
(USCEC-82-204; AFCRL-62-398; AD-282620)

Using the orthogonality relations of spheroidal functions, the exact solution for the problem of an unsymmetrically fed dielectric coated prolate spheroid is obtained. It is shown that due to the presence of the dielectric coating, each expansion coefficient for the radiated field is coupled with all expansion coefficients for the applied field. Consequently, the mode concept for an uncoated prolate spheroid, as introduced by Chu and Stratton and as elaborated by Schelkunoff, must be modified, and the definition for the "modes of oscillation" must be more specific. It is also demonstrated that all field expressions reduce to those for a coated spherical antenna as the spheroid degenerates to a sphere. Author

# 10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems, related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see:* 06 Auxiliary Systems.

**N64-14215** Advisory Group for Aeronautical Research and Development, Paris (France)
**NOTE ON THE EVALUATION OF THE LENGTH OF RUNWAYS NECESSARY FOR TAKE-OFF AND LANDING [NOTE SUR L'EVALUATION DES LONGUEURS DE PISTE NECESSAIRES POUR LE DECOLLAGE ET L'ATTERRISSAGE]**
J. Gremont (Centre d'Essais en Vol) Jan. 1963 13 p in FRENCH; ENGLISH Summary Presented at the Meeting of Specialists for Aircraft Take-Off and Landing under the Sponsorship of the AGARD Group of Flight Mechanics, Paris, 15-18 Jan. 1963
(AGARD-434)

This report presents discussions on: (1) the dispersion of actual measurements, on an aircraft, of the coefficient of the breaking of a wheel as a function of the velocity; (2) the dispersion of the stopping distances on a wet runway; (3) correlations between tests of aircraft and tests of light trailers; and (4) the calculation of the coefficient of friction of locked wheels. I.v.L

**N64-14216** Advisory Group for Aeronautical Research and Development, Paris (France)
**THE LOWERING OF MINIMAL WEATHER CONDITIONS FOR LANDING TRANSPORT AIRCRAFT [ABAISSEMENT DES CONDITIONS METEOROLOGIQUES MINIMALES POUR L'ATTERRISSAGE DES AVIONS DE TRANSPORT]**

R. Larrieu (Centre d'Essais en Vol) Jan. 1963 9 p In FRENCH; ENGLISH Summary Presented at the Meeting of Specialists for Aircraft Take-Off and Landing under the Sponsorship of the AGARD Group of Flight Mechanics, Paris, 15–18 Jan. 1963 (AGARD-436)

The lowering of minimum weather conditions for the landing of transport aircraft is reviewed. Results indicate that: (1) It is necessary, in order to land without acrobatics, for the approach at 100 ft to be made with sufficient precision as to the trajectory and the velocity so that the pilot will not be required to effect corrections. (2) It is useful and perhaps indispensable, in order for sufficient precision to be obtained, that the velocity be held with great precision by the copilot or by an automatic device. (3) The critical height of 100 ft should be measured with great precision and should be indicated without ambiguity on an instrument. (4) Dynamic breakdowns can probably be covered by internal safety devices. If pilot detection is not sufficiently rapid in critical cases, the automatic safety devices can act in a complementary manner. (5) Static breakdowns can be detected by external safety devices—the radiosonde for altitude, incidence for velocity, and the GCA for the trajectory. I.v.L.

**N64-14250** General Dynamics/Astronautics, San Diego, California

**COMPENDIUM OF WORLDWIDE TRACKING, TELEMETRY, AND RADIO ASTRONOMY FACILITIES**

Harry J. Phillips, comp. Sep. 1963 344 p
(GD/A63-0808)

Discussed are the characteristics and capabilities of existing ground based antennas and radio telescopes of which an understanding is necessary for the study, design, and development of the RATIO systems (Radio Telescope in Orbit). Attention is given to paraboloidal antenna systems applied to radio astronomy as well as to aerospace and deep space tracking, surveillance, and communication. C.L.W.

**N64-14262** Aerodynamische Versuchsanstalt, Gottingen (W. Germany)

**TEN YEARS OF AVA RECONSTRUCTION, 1953-1963 [10 JAHRE NEUAUFBAU 1953-1963]**

1963 85 p refs In GERMAN

This report includes discussions on: (1) the theoretical work, the IBM-650 electronic computer installation, the 3-m wind tunnel, the turbulent-poor wind tunnel, the 1-m wind tunnel, and the water tunnel of the aerodynamic division; (2) the theoretical work, the subsonic and supersonic wind tunnels, the transonic wind tunnel, the hot air wind tunnel, the cascade measuring section, and the compressor test stand of the gas dynamic division; and (3) the theoretical work of the aeroelasticity division that covers the elastic kinetics of aircraft, nonsteady aerodynamic forces, and aeroelastic instabilities. Also, the administration of the AVA is discussed. I.v.L.

**N64-14366** Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio

**A PORTABLE PRESENTATION PACKAGE FOR AUDIO-VISUAL INSTRUCTION**

Edgar A. Smith, Ralph E. Roberts, and William E. Brady (ASO) Nov. 1963 19 p
(AMRL-TDR-63-91; AD-427777) OTS: $0.50

The Portable Presentation Package is a prototype of a self-contained package of audio and visual equipment designed to facilitate technical training particularly in (1) remote areas, (2) situations in which written communications are difficult, and (3) situations requiring rapid on-the-spot preparation of instructional material. The package contains the essential components required in preparing and giving visual and audiovisual presentations to small groups. It is only slightly larger than an attache case, weighs 23 pounds, includes camera with light meter, projector with remote controls and supplementary lenses, projection screen, tape recorder and the necessary power cords and mirrors, and additional film and magnetic tapes. Descriptions and drawings are presented. Author

**N64-14369** RCA Service Co., Inc., Camden, N.J.

**A 100 KILOWATT ARC SOURCE FOR SOLAR SIMULATION**

Arnold Air Force Station, Tenn., Arnold Engineering Develop. Center, Jan. 1964 82 p refs
(Contract AF 40(600)-1029)
(AEDC-TDR-64-13; AD-428032)

A carbon arc burning mechanism, capable of operation at power levels in excess of 100 kw, was designed and built. Cored carbons of 25-mm and 35-mm sizes were burned at power levels from 40 to over 100 kw. Satisfactory stability of radiant intensity was obtained at relatively shallow angles between positive and negative electrodes. Polar intensity variations, microbrightness profiles, spectral distributions, and carbon consumption rates were obtained. Author

**N64-14413** Polish Academy of Sciences, Warsaw Inst. of Basic Technical Problems

**SCIENTIFIC ACTIVITIES OF THE INSTITUTE OF BASIC TECHNICAL PROBLEMS OF THE POLISH ACADEMY OF SCIENCES IN 1961**

1963 80 p refs

Research in the following areas is discussed: the theory of elasticity, the theory of plasticity; the theory of finite deformations; structural analysis; the theory of prestressed structures; the mechanics of stochastical media; experimental stress analysis; rarefied gas dynamics; gas flows considering thermodynamical nonequilibrium; general gas dynamics; periodical and unsteady flows of gases; the filtration theory; the theory of vibrations of mechanical systems and continuous media; acoustics and electroacoustics; ultrasonics; generation, stabilization, and analysis of electrical oscillations; electric modeling; electronic computers; the application of analogous mathematic machines and their elements; spectral analysis; semiconductors; magnetic materials; the theory of circuits; the theory of electromagnetic waves; the theory of information; metallurgy; plastic deformation of metals; physical metallurgy; a study of the macrostructure and microstructure and the properties of metal by means of radioactive isotopes; magnetic circuits; electrical-engineering measurement instruments; and small electrical machines. I.v.L.

**N64-14434** Kitt Peak National Observatory, Tucson, Ariz.

**Monthly Report, April 1963 [ACTIVITIES OF THE STELLAR, SOLAR, AND SPACE DIVISIONS AND PROGRESS ON THE CERRO TOLOLO INTER-AMERICAN OBSERVATORY]**

[1963] 13 p

Activities are reported as follows: (1) stellar division—assembly of the 84-in. telescope, observations with the 36-in. telescope, and stellar optics and stellar computer program; (2) solar division—McMath solar telescope assembly; (3) space division—data from the flight of the first Kitt Peak Aerobee rocket (KP 3.1); and (4) activities at the Cerro Tololo Inter-American Observatory, La Serena, Chile. R.T.K.

**N64-14435** Kitt Peak National Observatory, Tucson, Ariz.
**Monthly Report, Jun. 1963 [ACTIVITIES OF THE STELLAR, SOLAR, AND SPACE DIVISIONS AND PROGRESS ON THE CERRO TOLOLO INTER-AMERICAN OBSERVATORY]**
[1963] 15 p

During the months of May and June the microthermal sensors were in operation on two towers erected especially for this application. Seeing observations were made with double-beam telescopes. These observations were made at the time the microthermal records were taken. A description is given of the optical and electrical operations of the Polaris Image Motion Analyzer (PIMA). Reports are included on the 36-in. telescope, 84-in. telescope, 150-in. telescope, and West Ford project observations. The vacuum spectrograph was used to obtain spectra of the sunspot velocity fields and the nature of calcium faculae. A stabilization system is proposed for Aerobee rockets. A report is included from the Cerro Tololo Inter-American Observatory in Chile. R.T.K.

**N64-14436** Kitt Peak National Observatory, Tucson, Ariz.
**Monthly Report, Sep. 1963 [ACTIVITIES OF THE STELLAR, SOLAR, AND SPACE DIVISIONS AND PROGRESS ON THE CERRO TOLOLO INTER-AMERICAN OBSERVATORY]**
[1963] 13 p

The current program status includes: (1) The new primary and secondary mirrors have been installed in the 36-inch telescope. (2) Hartmann tests are continuing with the 84-inch telescope. Preliminary reductions indicate that some adjustments are needed in the back-support system. A computer program for the reduction of Hartmann plates has been completed. (3) The final design for the No. 2 coudé flat-field Schmidt camera has been completed. (4) Design criteria were derived for the field corrector systems for the proposed 150-inch telescope. (5) The McMath Solar Telescope is back in operation. (6) Efforts were concentrated on road construction in regard to the Cerro Tololo Inter-American Observatory. I.v.L.

**N64-14463** Royal Aircraft Establishment, Farnborough (Gt. Brit.)
**FIVE YEARS OF OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES IN POLAND [PIEC LAT OBSERWACJI SZTUCZNYCH SATELITOW ZIEMI W POLSCE]**
Ludoslaw Cichowicz London, Min. of Aviation, Nov. 1963 9 p refs Transl. into ENGLISH from Biul. Polskich Obs. Sztucnych Satelitow (Warsaw), no. 7, Jan. 1963 p 1–5
(RAE-TRANS-1052)

A description is given of the Polish organization for the optical observation of earth satellites, with some account of the instruments used and the numbers of observations made. Between 1957 and 1962 Polish stations made 19,242 observations on a total of 20 satellites; over 17,000 of these were of Echo 1. Author

**N64-14467** Air Force Flight Test Center, Edwards AFB, Calif.
**EVALUATION OF TAKE-OFF AND LANDING FACILITY**
Albert E. Taylor Jul. 1963 54 p
(FTFF-TM-58-12; AD-428384) OTS: $5.60

Static and dynamic tests were conducted to evaluate the AFFTC Take-Off and Landing Facility and to establish the degree of accuracy that can be expected when the facility is employed to obtain aircraft performance data during flight testing. The facility is described, and the results of the evaluation test are presented. Author

**N64-14573** Public Health Service, Washington, D.C. Div. of Radiological Health
**OFF-SITE RADIOLOGICAL MONITORING PROCEDURES FOR MISSILE TEST RANGES**
M. W. Carter, R. D. Coleman, and D. J. Nelson, Jr. *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 255–258 (See N64-14551 06-01) OTS: $4.50

The major emphasis of Public Health Service activities was directed toward the determination of current base levels of significant fission products and selected radionuclides of heavy elements that exist in the Atlantic Missile Range and the Pacific Missile Range off-site areas. The monitoring systems were adapted to measure specifically alpha radioactivity, since the radionuclide of concern in the SNAP launches has been plutonium-238. However, the systems are capable of detecting other radionuclides of health significance as required. R.T.K.

**N64-14666** Aerospace Corp., El Segundo, Calif. Labs. Div.
**ANALYSIS AND SIMULATION OF THE ANTENNA CONTROL SYSTEM FOR THE SPACE RADIO SYSTEMS FACILITY**
E. E. Reber and I. J. Williams 21 Dec. 1963 62 p
(Contract AF 04(695)-269)
(SSD-TDR-63-194; TDR-269(4250-41)-1; AD-427897)

The design and analysis are based upon linearized models of the components to be used for the proposed system. An analog simulation, performed to verify the design and analysis, to investigate relative signal levels, and to determine the effects of wind disturbances and nonlinearities, is described. It is shown that a system of this type can be designed to give satisfactory performance in the presence of expected nonlinearities and wind disturbances. Author

**N64-14682** Ohio State U., Columbus
**THE ARL THIRTY-INCH HYPERSONIC WIND TUNNEL INITIAL CALIBRATION AND PERFORMANCE Interim Technical Report, 15 Jan. 1962–15 Mar. 1964**
N. E. Scaggs, W. Burggraf, and G. M. Gregorek Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Dec. 1963 112 p refs
(Contract AF 33(657)-8106)
(ARL-63-223; AD-427751)

The ARL 30-in. hypersonic wind tunnel is a large blowdown facility that uses a methane–oxygen fired zirconia pebble bed to heat the air prior to expansion to flow Mach numbers ranging from 16 to 22 at free-stream Reynolds numbers approaching $10^6$/ft. This report describes the components of the facility, discusses the operation of the tunnel, and presents calibrations of two conical nozzles, developing approximately M = 16.5 and M = 18.5. The performances of the heater, diffuser, and vacuum system are evaluated, and the operational experiences gained during the initial operating period are reviewed. Author

**N64-14701** Philco Corp., Palo Alto, Calif. Western Development Labs.
**MAINTAINABILITY TEST AND DEMONSTRATION PLAN FOR NEW HAMPSHIRE STATION, MULTI-SATELLITE AUGMENTATION PROGRAM, PHASE "A"**
25 Jan. 1963 57 p refs
(Contract AF 04(695)-113)
(WDL-TR-2025; AD-299147)

The steps of the test and demonstration plan for the timing and control–display subsystems discussed in this report are: establishment of test objectives, specification of test conditions, selection of test samples, testing and collection of data, analysis of data, and reporting of test and demonstration results. R.T.K.

**N64-14725** Arinc Research Corp., Washington, D.C.
**ANALYSIS OF SAFETY ASPECTS OF AIRCRAFT LANDING OPERATIONS Final Report**
E. R. Jervis, J. R. Garafola, H. Dagen, and F. B. Brady Sep. 1963 163 p refs
(FAA Contract ARDS-573)
(*Its* Publ. 238-01-3-392)

A study was made to correlate equipment and operator failures with landing-operation safety in civil aircraft. Various equipment used in present instrument landing systems in jet aircraft of two major airlines and ground equipment of five airports were analyzed for an estimate of reliability and safety. From this estimate, figures of merit were determined for the various components of the systems; the figures of merit indicate the contribution to failure of the components or subsystems under various conditions, such as complete redundancy or single-series operation. They determine the effect of redundant elements on overall system reliability and on overall failure frequency. Author

**N64-14735** Federal Aviation Agency, Atlantic City, N.J. Evaluation Div.
**EVALUATION OF SIMPLIFIED APPROACH LIGHTING AIDS Final Report**
Thomas H. Paprocki Nov. 1963 44 p refs

In order to determine the most effective, yet economical, system or combination of systems for use on other than precision approach runways, the following approach lighting aids were evaluated: Rotating Incandescent Runway End Identifier Lights; Condenser Discharge Runway End Identifier Lights; Rotating Incandescent Approach Light Beacons; Condenser Discharge Approach Light Beacons; Simplified Approach Lighting System; Shortened Precision Approach Lighting System; and Wide Beam Circling Guidance Lights. Recommendations were made for modification and adoption of the Simplified Approach Lighting System as a standard for use on other than precision approach runways. Author

**N64-14739** Gt. Brit. Min. of Aviation, Mottingham Technical Information and Library Services
**THE INFLUENCE OF SLUSH ON THE TAKE-OFF RUN OF AIRCRAFT [DER EINFLUSS VON SCHNEEMATSCH AUF DIE STARTSTRECKEN VON FLUGZEUGEN]**
H. Herb Jan. 1964 16 p refs In ENGLISH
(TIL/T-5428; DFL-188)

A survey is given of the investigations on the effect of slush in lengthening the takeoff runs of aircraft. Because of the expense involved in measurements of this kind, no such experiments have yet been undertaken in Germany; the experience gained in other countries, which is reported here, could also be of value for conditions pertaining in Germany. Author

**N64-14830** Giannini Controls Corp., Berwyn, Pa. Astromechanics Research Div.
**MODEL FLY: ANALYSIS OF SUITABLE WIND TUNNELS**
J. A. Hill 30 Apr. 1963 10 p refs
(Contract AF 33(616)-8260)
(Tech. Letter 1310; AD-429059) OTS: $1.10

The Model Fly program is directed at the development of a complete dynamic wind-tunnel testing model technology for the early and inexpensive experimental determination of the following parameters for an air vehicle: (1) flight loads; (2) dynamic response characteristics; and (3) dynamic stability and control. An analysis of available wind tunnels in the U.S.A. and of requirements for the Model Fly program indicates that the 11- × 11-ft transonic wind tunnel located at the NASA Ames Research Center should be used to test the 1/10-scale elastic model of the F-106 aircraft. Similar analysis indicates that the transonic circuit tunnel at the Arnold Engineering Development Center should be used to evaluate the mount and inertia canceling device and to test the entire Model Fly system in the pitch plane. I.v.L.

**N64-14839** Library of Congress, Washington, D.C. Aerospace Information Div.
**SOVIET LITERATURE ON PROTECTIVE STRUCTURES AND COMPONENTS Comprehensive Report**
14 Nov. 1963 12 p refs
(AID-P-63-120; AD-428096) OTS: $1.60 ph, $0.80 mf

Ground support equipment of the Soviet Union is reviewed. Areas of interest are transportation, packaging, preservation, and storage. C.L.W.

**N64-14883** Johns Hopkins U., Baltimore, Md.
**THE TRANSPORTATION OF HIGHLY RADIOACTIVE MATERIALS – A REVIEW OF CURRENT RESEARCH**
J. Trueman Thompson Oct. 1963 27 p refs
(Contract AT(30-1)1477)
(NYO-9774) OTS: $0.50

Recognizing the need for a summary of the effort aimed at producing safe and economical shipping casks for high level radioactive materials, brief statements are given of the status of research at several facilities that have made significant contributions. The purposes, accomplishments, and plans for future efforts are recounted together with some findings and conclusions. Author

**N64-14920** Joint Publications Research Service, Washington, D.C.
**HOUSINGS OF ELECTRONIC MEDICAL EQUIPMENTS. DOSIMETRIC METHODS IN WAVE THERAPY**
Ye. L. Vayner et al 10 Feb. 1964 19 p refs Transl. into ENGLISH of 2 articles from Med. Prom. SSSR (Moscow), no. 11, 1963 p 5–17
(JPRS-23167; OTS-64-21529) OTS: $0.50

A discussion is presented of dosimetric methods in microwave and decimeter-wave therapy and of the choice of basic parameters for the standardization and classification of housings for electronic medical equipment. The errors in determining the dosimetry of both contact and remote applications of microwave and decimeter-wave therapy are discussed in particular, and the following conclusions are presented: (1) The dosimetry of absorbed radiation obtained by measuring the energy transmitted by the magnetron is fairly accurate for the contact method of radiation using microwaves of the 12-cm range and produces errors not exceeding 30% to 40%. (2) The remote method of radiation by microwaves makes the absorbed energy dependent, to a considerable extent, on the distance between the emitter and the body and on the size of the emitter. If these conditions for the radiation are constant, the value of the absorbed energy can be reproduced with fair accuracy from the measurement of the transmitted energy, and the absolute value of the absorbed energy can be estimated with the aid of suitable corrective coefficients. (3) The contact method, when using the decimeter range of waves, provides a fairly accurate dosimetry for the absorbed energy. It also makes it possible to estimate with more precision (than when using the 12-cm range) the distribution of the energy in the mass of the body tissues. P.V.E.

**N64-14935** Federal Aviation Agency, Washington, D.C. Systems Research and Development Service
**CONTROL LOAD, CONTROL CAPACITY, AND OPTIMAL SECTOR DESIGN Interim Report**
Bar-Atid Arad, Benjamin T. Golden, James E. Grambart (FAA, Atlantic City), Clifton E. Mayfield, (Franklin Inst.) and H. Richard van Saun Dec. 1963 102 p refs
(RD-64-16)

The complexity of total traffic phenomena in a controlled airspace is described by a model that relates the variables of the traffic (number of aircraft, distribution, speed), the rules of operation (separation minima), and the airspace (volume and flow organization) to the load that is imposed on the control position of the sector. Basic units of control load and control work are defined and used for quantification of the control effort required. The relationship between the load imposed on the control position and the geometry and the orientation of the sector is demonstrated, and a method for optimizing the design of the sector is analyzed and described in a numerical example. The control capacity is quantified in units of control load, and a method of matching the size of the sector to the capacity for maximum efficiency of sector design is demonstrated and discussed. Author

**N64-14975** ARO, Inc., Arnold Air Force Station, Tenn.
**THE AERODYNAMIC CALIBRATION OF THE AEDC 16-FOOT SUPERSONIC TUNNEL COMPRESSOR WITH THE FIRST CYLINDER REMOVED**
C. L. Garner, Jr. Arnold Eng. Develop. Center, Feb. 1964 38 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-16; AD-428813)

The aerodynamic performance has been investigated at an inlet temperature of approximately 55° F and compressor exit pressure levels of 300 and 1200 psfa at the design speed of 600 rpm. The overall performance of the three-cylinder configuration was considerably improved when the first and second cylinder stator blade settings were mismatched 6 deg. This change increased the maximum three-cylinder configuration pressure ratio from 4.59 to 5.00. The maximum pressure ratios available are 1.57 at 108,800 cfs, 2.58 at 113,500 cfs, and 5.00 at 109,000 cfs for the one-, two-, and three-cylinder configurations, respectively. Increasing the stagnation pressure from 300 to 1200 psfa produced up to a 10-percent increase in volume flow for the two-cylinder configuration and up to an 11-percent increase in volume flow for the three-cylinder configuration. Author

**N64-14976** Southwest Research Inst., San Antonio, Tex.
**TRACKING MECHANISMS AND COUPLINGS FOR A CARGO RESUPPLY TRAIN CONCEPT: PHASE IIB LATERAL STABILITY OF TRAILER TRAINS Final Technical Report**
Fred Jindra et al Ft. Eustis, Va., Transportation Res. Command., Sep. 1963 170 p refs
(Contract DA-44-177-TC-631)
(AR-467-A; TRECOM-TR-63-46; AD-421999)

Analytical solutions are developed for lateral stability of trailer trains. For three-unit trains, stability is assessed by determining roots of characteristic equations. For trains of more than three units, equations are integrated numerically to obtain time-history of response. Results are given for typical trains of three, six, ten, and thirteen units. Parametric studies are conducted to show the effect on stability of such items as wheelbase, drawbar length and forces, steering ratio, tire cornering forces, and torque dampers. It is found that steering ratio and tire cornering force have the greatest influence on stability. Author

# 11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

**N64-14239** Royal Aircraft Establishment, Farnsborough (Gt. Brit.)
**ON CERTAIN QUESTIONS IN THE HYDRODYNAMICS OF RELAXING MEDIA [O NEKOTORYKH VOPROSAKH GIDRODINAMIKI RELAKSIRUYUSHCHIKH SRED]**
I. P. Stakhanov and Ye. V. Stupochenko London, Ministry of Aviation, Oct. 1963 32 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekh. Fiz. (Moscow), no. 2, 1963 p 3-20
(RAE-TRANS-1047)

Some general properties of the flow equations for relaxing media are considered on the basis of the phenomenological theory of irreversible processes. The transition to equilibrium flow when relaxation time becomes vanishingly small is discussed. Solutions for the problems of the unsteady propagation of a weak shock wave, the flow about a slender wedge, and the propagation of small disturbances in the relaxation zone are given for an inviscid and non-heat-conducting gas. Author

**N64-14303** Texas U., Austin Defense Research Lab.
**PRANDTL NUMBER DISTRIBUTION IN A TURBULENT BOUNDARY LAYER WITH HEAT TRANSFER AT SUPERSONIC SPEEDS**
William C. Rochelle Oct. 1963 124 p refs
(Grant DA-ORD-31-124-61-G3; Grant DA-ORD(D)-31-124-G132)
(DRL-508; AD-427156)

This report contains a description of the investigation which determined the Prandtl number distribution across a turbulent, compressible boundary layer, both with and without heat transfer at the wall. The calculations were performed by integrating the continuity, momentum, and energy equations, and by using an iteration process to determine the velocity and temperature profiles. The Prandtl numbers for the adiabatic cases ranged from about 0.89 near the wall to about 1.0 near the free stream for a wide range of Mach and Reynolds numbers. For the heat-transfer cases, the Prandtl numbers varied from about 0.75 near the wall to a value of about 1.0 near the free stream when using a fourth-order temperature–velocity equation, and from about 0.90 near the wall to about 1.0 near the free stream when using a third-order equation. Author

**N64-14320** Southampton U. (Gt. Brit.)
**SPACE TIME CORRELATIONS OF THE BOUNDARY LAYER PRESSURE FIELD IN NARROW FREQUENCY BANDS Technical Report, Jan. 1960 - Nov. 1961**
M. K. Bull Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Nov. 1963 30 p refs
(Contract AF 61(052)-358)
(A.A.S.U. 200; ASD-TDR-62-722; AD-425694)

Expressions are derived for the space–time correlation of the surface pressure field of a turbulent boundary layer in narrow frequency bands. On the basis of convection of an "almost frozen" pressure field, the amplitude of the filtered correlation in the flow direction is found to be dependent on spatial separation but independent of frequency. Empirical representations

of the overall correlations of the pressure field and experimental measurements are given to illustrate the results obtained.
Author

**N64-14403** Rensselaer Polytechnic Inst., Troy, N.Y.
**ENERGY SEPARATOR**
J. V. Foa Jan. 1964 16 p refs
(TR-AE-6401)

This report discusses a cryptosteady process whereby an initially homogeneous flow is divided into separate homogeneous flows at different energy levels. This process finds its only steady-flow counterpart in the highly dissipative mechanism of the Ranque–Hilsch tube. The process lends itself to applications in heating, cooling, air-conditioning, and pumping apparatus.
I.v.L.

**N64-14466** Mississippi State U., State College
**SOME CHARACTERISTICS OF THE TURBULENT BOUNDARY LAYER**
Gary N. Smith Ft. Eustis, Va., Army Transportation Res. Command, Dec. 1963 27 p refs
(Contract DA-44-177-AMC-892(T))
(TRECOM-TR-63-74; AD-428377) OTS: $2.60

From an examination of the turbulent boundary layer profile, several relations are derived relating various parameters of a turbulent boundary layer. These relations are shown to have limits of application, and these limits are defined. Finally, the theories are compared with experimental data and show good agreement.
Author

**N64-14520*** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
**NUMERICAL SOLUTIONS OF KNUDSEN FLOW ENTERING A CIRCULAR TUBE THROUGH A SMALL AXIAL ORIFICE**
Edward A. Richley and Carl D. Bogart Washington, NASA, Feb. 1964 47 p refs
(NASA TN D-2115) OTS: $1.25

The problem of determining Knudsen flow-flux distributions in certain models pertinent to electric rocket thrustor design is discussed. A basic model of circular cross section is established in which particles are assumed to enter one end through a small orifice and leave the other end which is wholly open. Analyses are given for the cases of diffuse and specular reflections from the walls. For diffuse reflection, the resulting integral equations are solved by an iterative procedure on an IBM 7094 computer. Flux distributions are presented for the rear wall, the side wall, and the open end of the basic model. For the case of specular reflection, approximate solutions are obtained by a method of ray tracing.
Author

**N64-14656*** Ling-Temco-Vought, Inc., Dallas, Tex.
**ON THE TURBULENT SHEAR FLOW OF AN ELASTICO-VISCOUS FLUID**
C. Sinclair Wells, Jr. N.Y., AIAA [1963] 11 p refs Presented at the AIAA Aerospace Sci. Meeting, New York, 20–22 Jan. 1964
(NASA Contract NASw-729)
(AIAA Paper 64-36) Available from AIAA: $0.50 members, $1.00 non-members

The turbulent shear flows discussed are those that are constrained—fully constrained, as in the case of flow in a pipe or channel, as well as half constrained, as in the case of a boundary-layer flow. Turbulent shear flow of Newtonian fluid solvents with small concentrations of high-molecular-weight polymers, presumed to be elastico-viscous fluids, demonstrated a reduction in frictional drag over that of the Newtonian solvents. The drag reduction increased with increasing Reynolds number, although there was a pronounced effect of diameter on the drag results. A viscous sublayer was found to lie adjacent to the constraining wall for these fluids. The variation of velocity with distance from the wall approached, near the wall, a relation derived for a constant shear stress flow, and is based on the viscous-fluid properties only. The variation of velocity with distance from the wall was found to approach, far from the wall, a relation based on the Prandtl mixing-length concept and a variable mixing-length constant. The edge of the viscous sublayer was predicted by a stability criterion stating that turbulence occurs when the ratio of turbulent to laminar shear stresses reaches a universally constant value. The edge of the sublayer was not a well-defined point, but was rather a region of transition from the viscous effects to the turbulent effects.
R.T.K.

**N64-14693** California U., Berkeley
**FLAT PLATE SKIN FRICTION IN LOW DENSITY HYPERSONIC FLOW-APPARATUS DEVELOPMENT**
E. S. Moulic Wright-Patterson AFB, Ohio, Aerospace Res. Lab., Dec. 1963 21 p refs
(Contract AF 33(657)-8607)
(ARL-63-224; AD-427768)

An apparatus designed to measure local skin friction near the sharp leading edge of a flat plate by the floating element technique was subjected to a critical evaluation in a low-density Mach 6 wind tunnel. It was found that the accuracy of the data was strongly influenced by extremely small (50 $\mu$in.) irregularities on the model surface, and it was concluded that further model refinement was needed.
Author

**N64-14703** Kraichnan (Robert H.), Peterborough, N.H.
**APPROXIMATIONS FOR STEADY-STATE ISOTROPIC TURBULENCE Research Report No. 3**
Robert H. Kraichnan Sep. 1963 16 p refs
(Contract Nonr-3999(00))
(AD-425829)

The direct-interaction approximation for turbulence maintained by stationary, isotropic, random stirring forces is formulated in the wave number frequency domain. Further, simplifying approximations are made. The final equations involve the wave number energy spectrum, a characteristic correlation frequency for each wave number, and a characteristic response frequency for each wave number. A relation is exhibited between the simplified equations and a Fokker–Planck type approximation.
Author

**N64-14704** Kraichnan, (Robert H.), Peterborough, N.H.
**DECAY OF ISOTROPIC TURBULENCE IN THE DIRECT-INTERACTION APPROXIMATION Research Report No. 4**
Robert H. Kraichnan Nov. 1963 50 p refs
(Contract Nonr-3999(00))
(AD-425830)

The direct-interaction equations for the decay of isotropic turbulence are integrated numerically with initial spectra of several shapes and initial values of $R\lambda \leq 40$. Results are presented for the evolution with time of total energy, dissipation, energy transfer, skewness factor, and other integral quantities, together with the associated wave number spectra. Similarity and self-preservation features of the evolving spectra are exhibited. The results are compared with grid-turbulence measurements. Results are also given for the time-correlation of the total velocity at a fixed point in space and for the time-correlation and response functions of individual wave number modes.
Author

**N64-14706** Kraichnan (Robert H.), Peterborough, N.H.
**DIRECT-INTERACTION APPROXIMATION FOR SHEAR AND THERMALLY-DRIVEN TURBULENCE Research Report No. 2**
Robert H. Kraichnan Sep. 1963 46 p refs
(Contract Nonr-3999(00))
(AD-425745)

The direct-interaction approximation for turbulence is extended to shear flows and Boussinesq convection contained in regions of arbitrary size and shape. It is pointed out that the approximation provides a consistent generalization of mixing-length concepts, which continues to be applicable when the scale of inhomogeneity is comparable to the effective mixing length. The degree of faithfulness of the approximation is discussed on the basis of inferences from numerical results on isotropic turbulence. Author

**N64-14780** Aerospace Corp., San Bernardino, Calif.
**APPROXIMATE NONEQUILIBRIUM AIR IONIZATION IN HYPERSONIC FLOWS OVER SHARP CONES**
E. S. Levinsky and F. L. Fernandez 8 Nov. 1963 22 p refs Presented at the 8th Symp. on Ballistic Missile and Space Technol., Re-Entry Aerophys. I. Sess.
(Contract AF 04(695)-269)
(BSD-TDR-63-231; TDR-269(S4810-60)-1; AD-425900) OTS: $2.60

A simplified chemical kinetic model is proposed for the thermal ionization of air, permitting approximate closed-form solutions for the electron distribution in the inviscid flow field and boundary layer of sharp cones. As long as the gas is still far out of equilibrium and the frozen temperature distribution remains valid, the electron density per unit pressure $N_e/P$ is found to vary with the similarity parameter $(PX/V)^3$ confirming binary scaling. An extreme dependence of electron density on cone angle ($N_e \sim \theta_c^8$) and length ($N_e \sim X^3$) is found. Author

**N64-14911*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**EFFECTS OF CONTROLLED ROUGHNESS ON BOUNDARY-LAYER TRANSITION AT A MACH NUMBER OF 6.0**
James R. Sterrett and Paul F. Holloway Repr. from AIAA J., v. 1, no. 8, Aug. 1963 refs

An investigation of hypersonic boundary-layer transition on a smooth flat plate with a sharp leading edge (leading edge thickness less than 0.002 in.) and with or without controlled roughness is discussed. The results of the investigation are summarized in tabular form, and the experimental "critical" roughness Reynolds numbers are compared with those found in previous studies at lower supersonic Mach numbers ($M < 4.8$). The critical roughness Reynolds numbers increased sharply for the higher Mach numbers studied (4.8 to 6.0). It is shown experimentally that the roughness parameter $k/\delta$ (k is the vertical height of the spheres above the plate surface, and $\delta$ is the calculated boundary-layer thickness at the roughness location) required to move the beginning of fully developed turbulent flow approximately to the roughness position is much greater for higher supersonic and hypersonic Mach numbers than that previously established for low supersonic Mach numbers. P.V.E.

**N64-14939*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**A STEADY-STATE ANALYSIS OF THE "LAMINAR-INSTABILITY" PROBLEM DUE TO HEATING PARA-HYDROGEN IN LONG, SLENDER TUBES**
David P. Harry III Washington, NASA, Feb. 1964 39 p refs
(NASA TN D-2084) OTS: $1.00

An analysis of steady-state pressure-drop characteristics in long, slender, circular tubes related to the "laminar-instability" problem is presented. Results obtained by detailed numerical computations are based on real-fluid para-hydrogen properties and assumed laminar to turbulent and turbulent to laminar flow transition criteria. Correlation parameters are derived from approximate solutions of flow and heat-transfer relations and are used to generalize calculated pressure drop over the Reynolds number range of mixed turbulent and laminar flows. Results indicate that the minimum pressure drop occurs within or near the range of mixed turbulent and laminar flows. The range of conditions investigated includes inlet pressures of 1 to 1000 psia, inlet temperatures of 50° to 150° R, tube lengths up to 6 ft, and tube diameters from 0.05 to 0.3 in. Heat input is varied to produce temperature ratios up to 80, and inlet flow or Mach number varies over a range of four decades. Author

**N64-14941*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**FLUID OSCILLATIONS IN THE CONTAINERS OF A SPACE VEHICLE AND THEIR INFLUENCE UPON STABILITY**
Helmut F. Bauer Washington, NASA, Feb. 1964 149 p refs
(NASA TR R-187) OTS: $3.00

To obtain the eigenfrequencies and mode shapes of a liquid, forced oscillations of a frictionless fluid in a cylindrical container of circular ring-sector cross section are treated. The assumption of frictionless liquid is justified, since only very small damping is provided by the friction at the tank walls. In a cylindrical container, the lower part of the liquid performs the forced oscillation like a rigid body, and only the liquid in the immediate vicinity of the free surface moves independently. The oscillating propellant can be represented as a spring-mass-system, in which location and magnitude of the model values are determined to give the same forces and moments as the liquid. After the introduction of the mechanical model for the propellants, the derivation of the equations of motion presents no problem. The influence of propellant sloshing is then determined by stability boundaries. This paper gives the results of theoretical studies for the response of the liquid in an arbitrary cylindrical ring-sector container, derives the model for the most frequently used tank forms, and presents stability boundaries for various control systems. Author

# 12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

**N64-14200** Bayerische Akademie der Wissenschaften, Munich (W. Germany) Deutsche Geodätische Kommission
**GERMAN NATIONAL REPORT ON ACTIVITIES CARRIED OUT IN 1960-1962 [DEUTSCHER LANDESBERICHT UBER DIE IN DEN JAHREN 1960 BIS 1962 AUSGEFUHRTEN ARBEITEN]**
Max Kneiss et al 1963 77 p refs In GERMAN Presented to the 13th Gen. Meeting of the Intern. Union for Geodesy and Geophys.
(*Its* Reihe B: Angew. Geodäsie, No. 103)

Activities presented in this report cover the following areas: (1) methods of determining geodetic positions; (2) leveling and coastline movement; (3) geodetic astronomy and artificial satellites; (4) gravimetry; and (5) physical geodesy. Also, the history and importance of international earth measurement are discussed. I.v.L.

**N64-14363** Emmanuel Coll., Boston, Mass. Research Language Center
**THE OROGRAPHY OF THE NORTHERN HEMISPHERE EXPRESSED BY SPHERICAL FUNCTIONS**
Richard M. Holden, ed. Jul. 1963 16 p ref Transl. into ENGLISH from Chin Shu Hsueh Pao (Peking), v. 30, no. 4, 1959 p 405–413
(Contract AF 19(604)-8505)
(E-T-Ch-63-8; AD-424536)

This paper presents an orographic chart for the Northern Hemisphere according to the data of the orographic height above mean sea level as given by Berkofsky. It was found that the chart, expressed by spherical functions, is in fair agreement with that prepared by Berkofsky, except in the region near the North Pole. Author

**N64-14405*** National Aeronautics and Space Administration, Washington, D.C.
**DETERMINATION OF THE MAGNETIC FIELD GRADIENT IN THE SOLAR PHOTOSPHERE [OPREDELENIYE GRADIYENTA MAGNITNOGO POLYA V FOTOSFERE SOLNTSA]**
V. Ye Stepanov Jan. 1964 12 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 22, 1960 p 42–48
(NASA TT F-138) OTS: $0.50

Records of the longitudinal component of magnetic-field intensity in an active region of the sun's surface for the far and near wings of the Na line $D_1$, taken by a magnetograph, are used to determine the field at two photosphere levels. It is established that the magnetic field in the photosphere increases with depth and that its average variation equals 0.026 to 0.035 gauss/km. Author

**N64-14415*** National Aeronautics and Space Administration, Washington, D.C.
**INDIA-U.S. CONTINUE COOPERATIVE SPACE RESEARCH**
**News Release No. 64-19**
28 Jan. 1964 3 p

A program is discussed wherein a series of four sounding rockets are to investigate the equatorial electrojet, a current flowing along the earth's magnetic equator at an altitude of about 60 miles. The electrojet is to be studied by means of a rocket magnetometer designed to determine the geographic location, height, and intensity during the period when the 11-yr cycle of solar activity is near its minimum. The magnetometer also permits observation of changes in the vertical structure of the electrojet at different times during the day, at different times during a lunar cycle, and during various degrees of magnetic disturbance. Three sodium-vapor payloads have already been successfully launched in the program. Their objective was to measure atmospheric turbulence and wind shears, diffusion, and density. C.L.W.

**N64-14446** Council of Scientific and Industrial Research, New Delhi (India) Radio Research Committee
**IONOSPHERIC DATA, AUGUST, 1962**
1962 65 p
(RRC-A87)

The ionospheric data presented for August 1962, are those of Delhi (Radio Propagation Unit, National Physical Laboratory), Bombay, Madras, Tiruchirapalli and Trivandrum (Research Department, All India Radio), Haringhata (Calcutta) (Institute of Radiophysics and Electronics), Ahmedabad (Physical Research Laboratory), and Kodaikanal (Astrophysical Observatory, India Meteorological Department). The geographic, geomagnetic, and magnetic locations of the stations are given along with some relevant information concerning the equipment used. I.v.L.

**N64-14447** Council of Scientific and Industrial Research, New Delhi (India) Radio Research Committee
**IONOSPHERIC DATA, SEPTEMBER, 1962**
1962 64 p
(RRC-A88)

The ionospheric data presented for September 1962, are those of Delhi (Radio Propagation Unit, National Physical Laboratory), Bombay, Madras, Tiruchirapalli and Trivandrum (Research Department, All India Radio), Haringhata (Calcutta) (Institute of Radiophysics and Electronics), Ahmedabad (Physical Research Laboratory), and Kodaikanal (Astrophysical Observatory, India Meteorological Department). The geographic, geomagnetic, and magnetic locations of the stations are given along with some relevant information concerning the equipment used. I.v.L.

**N64-14460** International Council of Scientific Unions, Paris (France)
**GREAT BRITAIN AND BRITISH OVERSEAS TERRITORIES: NATIONAL REPORT OF GEODESY FOR 1960-1962**
Aug. 1963 22 p refs Presented at the Gen. Assembly of the Intern. Assoc. of Geodesy, Berkeley, Calif., 21–28 Aug. 1963

This report discusses accomplishments in the following areas: (1) triangulation; (2) geodetic leveling; (3) geodetic astronomy; (4) gravity measurements and gravity-meter surveys; and (5) physical geodesy. I.v.L.

**N64-14521** Joint Publications Research Service, Washington, D.C.
**ON THE NATURE OF THE STRATIFICATION OF THE EARTH'S CRUST AND THE UPPER MANTLE**
Yu. V. Riznichenko and I. P. Kosminskaya 24 Jan. 1964 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 2, 11 Nov. 1963 p 323–325
(JPRS-22886; OTS-64-21381) OTS: $0.50

It appears that the deep seismic boundaries and, accordingly, the strata are a consequence of the combined effect of changes, both in the composition and in the state of the matter under conditions of the changing regime of temperatures and pressures and the transfer of matter within the interior of the earth. They represent some fronts of metamorphism peculiar to fixed, quite narrow intervals of depth, at least in stable platform conditions. The position and form of the deep boundaries, in conjunction with the structures in the sedimentary strata, reflect the nature of crustal movements in the recent geological past up to the present time. In spite of the "nongeological" nature of these "geophysical" boundaries, their study should be of primary interest in the solution of a number of the most important geological problems associated with the formation and development of the earth's crust and the upper mantle. I.v.L.

**N64-14524** Joint Publications Research Service, Washington, D.C.
**INFORMATION ON SCIENTIFIC WORKS IN PHYSICAL OCEANOGRAPHY, 1960-1962**
31 Jan. 1964 18 p Transl. into ENGLISH from "Soobshcheniye o nauchnykh rabotakh po fizicheskoy okeanografii 1960–1962 gg", Moscow, Acad. of Sci. USSR, 1963 p 3–12 Presented at the 13th Gen. Assembly of the Intern. Union of Geodesy and Geophys.
(JPRS-23025; OTS-64-21456) OTS: $0.50

This report contains discussions on the following: (1) the physics and chemistry of the ocean and the atmosphere above it; (2) marine biology; (3) marine geology; (4) coastal oceanography; and (5) methods and techniques of oceanological research. I.v.L.

**N64-14533** Joint Publications Research Service, Washington, D.C.
**SEISMICITY AND DEEP STRUCTURE OF THE SOUTHERN PART OF THE KURILE ISLAND ARC**
S. A. Fedotov et al 6 Feb. 1964 8 p refs Transl. into ENGLISH of an article from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 3, 21 Nov. 1963 p 668–671
(JPRS-23102; OTS-64-21495) OTS: $0.50

Detailed seismological investigations were made in the southern part of the Kuriles during the period 1958 to 1962 for the purpose of obtaining precise data on the seismicity and properties of the upper mantle for this section of the island arc. The investigations revealed that in this area the earthquake foci are distributed far more uniformly and closer together than had previously been assumed. In the area of the southern Kurile islands, there are almost no earthquakes at a depth greater than 200 km. The distribution of foci of these earthquakes is not random but, on the contrary, is uniform and stable. R.T.K.

**N64-14534** Joint Publications Research Service, Washington, D.C.
**SOME RESULTS OF GEOPHYSICAL STUDIES OF THE EARTH'S CRUSTAL STRUCTURE IN THE ANTARCTIC NORTH OF THE NOVOLAZAREVSKAYA STATION**
V. A. Gladun et al 6 Feb. 1964 6 p refs Transl. into ENGLISH of an article from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 6, 21 Dec. 1963 p 1398–1399
(JPRS-23107; OTS-64-21499) OTS: $0.50

The thickness of the earth's crust in the vicinity of the Lazarev station is about 30 km; to the south it increases rapidly and reaches 40 km at the northern edge of the Vol'tat mountain massif. The thickness of the crust gradually decreases from 30 to 27 km within the limits of the shelf zone to the north. The transitional zone, within the limits of which the depth of the Mohorovičić discontinuity gradually decreases from 27 to 15 km, extends far to the north and also finds its reflection in the relief of the bottom of the sea. The depth of the Mohorovičić discontinuity in the region of the African-Antarctic basin is about 9 km, and the thickness of the crust is about 5 km. The alteration of zones of negative and positive Faye anomalies from south to north is predetermined to a considerable degree by the relief of the Mohorovičić discontinuity. I.v.L.

**N64-14537** Joint Publications Research Service, Washington, D.C.
**STRUCTURE OF THE EARTH'S CRUST IN SIBERIA AND THE FAR EAST ACCORDING TO DATA OF REGIONAL GEOPHYSICAL INVESTIGATIONS**
E. E. Fotiady and G. I. Karatayev 7 Feb. 1964 28 p refs Transl. into ENGLISH of an article from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), no. 10, 10 Oct. 1963 p 5–19
(JPRS-23133; OTS-64-21518) OTS: $0.75

A variant of a schematic map of the structure of the earth's crust of Siberia and the Far East, showing thickness of the crust (large forms of Moho discontinuity) and its subdivision in various structural types and subtypes, is discussed. The map was compiled on the basis of the appropriate interpretation of the latest regional studies, primarily gravimetric, properly treated in accordance with a new method using an electronic computer. The map may serve as a basis for discussions of a number of problems concerning the deep structure of the earth's crust, and also for defining, in the observed field, the forces of gravity of the regional anomalies caused by the relief of the Moho. I.v.L.

**N64-14538** Joint Publications Research Service, Washington, D.C.
**STUDIES ON SEISMIC OBSERVATION METHODS**
7 Feb. 1964 50 p refs Transl. into ENGLISH of 3 articles from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), no. 9, Sep. 1963 p 66–101
(JPRS-23134; OTS-64-21519) OTS: $1.25

CONTENTS:
1. A THEORY OF INTERPRETING ISOLATED SEISMIC OBSERVATIONS N. N. Puzyrev p 1–21 refs
2. POSSIBILITY OF MAPPING PALEOZOIC DEPOSITS IN THE RUDNYY ALTAY BY A SEISMIC METHOD I. P. Mikhelev p 22–34 refs
3. EXPERIENCE IN APPLICATION OF HIGH-FREQUENCY SEISMIC SURVEYS (REFLECTED WAVE METHOD) FOR INVESTIGATIONS OF WEDGE-OUT ZONES IN THE SOUTHERN PART OF THE WEST SIBERIAN LOWLANDS B. A. Kanareykin p 35–47 refs

**N64-14543** Joint Publications Research Service, Washington, D.C.
**THE NATURE OF VERTICAL MOVEMENTS OF THE EARTH'S CRUST AS INDICATED BY DATA ON EUROPEAN ISOSTATIC ANOMALIES**
M. Ye. Artem'yev 6 Feb. 1964 9 p refs Transl. into ENGLISH of an article from Dokl. Akad. Nauk SSSR (Moscow), v. 153 no. 3, 21 Nov. 1963 p 664–667
(JPRS-23103; OTS-64-21496) OTS: $0.50

Isostatic gravity anomalies of three areas of Europe were used as a method for indicating the character of deep processes and for evaluating the ideas concerning the mechanism of tectonic movements as expressed in various geotectonic hypotheses. Results indicate that certain data on the isostatic state of different sectors of the earth's crust are inadequate for an unambiguous judgment concerning the nature of geological movements. For such an analysis, it is especially important to have reliable information on the geological history of the area in question. Nevertheless, information on the nature of tectonic movements contained in gravity anomalies is of sufficient importance that it should be taken into account in attempts to devise various models of tectonic processes. I.v.L.

**N64-14610** Joint Publications Research Service, Washington, D.C.
**SOVIET AERIAL SURVEYING AND GEOLOGY**

4 Feb. 1964 33 p refs Transl. into ENGLISH of two articles from "Razrabotka i preimeneniye aerometodov v geologo-geofizicheskikh issledovaniyakh", Moscow, Izd. An SSSR, 1963 135 p
(JPRS-23073; OTS-64-21483) OTS: $1.00

CONTENTS:

1. AERIAL GEOPHYSICS FOR GEOLOGICAL RESEARCH N. D. Palitsyn and A. V. Dolivo-Dobrovol'skiy p 1–10 (See N64-14611 06-12)

2. THE NATURE OF THE AEROMAGNETIC ANOMALIES OF THE POROSOZERO SUITE N. D. Palitsyn, A. V. Dolivo-Dobrovol'skiy, and Yu. V. Podol'skiy p 11–30 refs (See N64-14612 06-12)

**N64-14611** Joint Publications Research Service, Washington, D.C.
**AERIAL GEOPHYSICS FOR GEOLOGICAL RESEARCH**
N. D. Palitsyn and A. V. Dolivo-Dobrovol'skiy *In its* Sov. Aerial Surv. and Geol. 4 Feb. 1964 p 1–10 (See N64-14610 06-12) OTS: $1.00

Questions concerning the applicability of aerial geophysical methods for geological research are summarized. The basic problems and prospects for developing aerial geophysical methods are also given, and the question on the place of aerial geophysics in the general range of geological research is reviewed. The article stresses the necessity of using aerial geophysics in all stages of studying the geology of a region. It was concluded that the development of aerial geophysics must proceed along the line of creating new aerial geophysical methods and working out new equipment, through the use of existing methods for solving the different geological problems under various conditions. C.L.W.

**N64-14612** Joint Publications Research Service, Washington, D.C.
**THE NATURE OF THE AEROMAGNETIC ANOMALIES OF THE POROSOZERO SUITE**
N. D. Palitsyn, A. V. Dolivo-Dobrovol'skiy, and Yu. V. Podol'skiy *In its* Sov. Aerial Surv. and Geol. 4 Feb. 1964 p 11–30 (See N64-14610 06-12) OTS: $1.00

Results are given from work showing the geological nature of aeromagnetic anomalies from the Porosozero Suite. Quartz–magnetite–amphibole rock discovered in checking the aeromagnetic anomalies is described. Data obtained make it necessary to introduce basic changes in the geological map and to significantly improve the accuracy in the stratigraphy of the Porosozero Suite. Author

**N64-14643** Aerospace Corp., El Segundo, Calif. Labs. Div.
**TRAPPED PROTONS AT LOW ALTITUDES IN THE SOUTH ATLANTIC MAGNETIC ANOMALY**
S. C. Freden and G. A. Paulikas 16 Dec. 1963 32 p refs (Contract AF 04(695)-269)
(SSD-TDR-63-342; TDR-269(4260-20)-1; AD-428493)

The fluxes of protons from 5 to 20 Mev and 60 to 120 Mev were measured. The ratio of the fluxes in these two energy intervals is essentially independent of B and is independent of L below $L \sim 1.4$ but changes rapidly for $L > 1.4$. The flux in the 5- to 20-Mev interval indicates that the spectrum turns back up below the local minimum (at $L \leq 1.5$) near 20 Mev. This result is consistent with an increased absorption in the atmosphere for the albedo neutrons near 20 Mev. The integral flux above 31 Mev appears to have increased by a factor of about 3 at the lower L values and higher B values since the Explorer IV measurements. Author

**N64-14654** Pennsylvania State U., University Park Ionosphere Research Lab.
**DESIGN AND ANALYSIS OF AN INSTRUMENTATION SYSTEM FOR THE MEASUREMENT OF IONOSPHERIC CROSS-MODULATION**
R. L. Suttmiller 15 Feb. 1964 93 p refs
(NSF Grant GP-846)
(Sci. Rept. 205(E))

Basic concepts as introduced by Fejer and the addition of some unique circuitry have been incorporated in the amplitude interaction instrumentation designed for this experiment. This instrumentation has been successfully used to measure the interaction effect. The amplitude interaction system has been evaluated in terms of the diurnal and seasonal variation of the signal-to-noise power ratio expected for a low sunspot period, such as IQSY, and a high sunspot period. It has been predicted that the signal-to-noise power ratio can vary during the day from 5 to 100 during IQSY and from 0.01 to 30 during a high sunspot period. It has also been shown that this system can be used to detect weak echoes, such as partial reflections. Author

**N64-14660** Pennsylvania State U., University Park
**MODEL STUDIES OF SEISMIC ENERGY DISTRIBUTION AROUND DIFFERENT TYPES OF COURSE Final Report**
B. F. Howell, Jr. and P. M. Lavin 20 Dec. 1963 10 p refs (Contract AF 19(604)-7383; ARPA Order 180-61, Amend. 2; Proj. Vela-Uniform)
(AFCRL-64-211; AD-427869)

An attempt was made to find a mathematical equivalent of an earthquake source comprising a system of suddenly applied forces acting at the focus that would deliver the same pattern of seismic waves as the earthquake itself. Two-dimensional seismic models were investigated. The amplitudes of the first motions of P and S waves as a function of azimuth from the source were recorded and plotted for eight models. The effect of near-source inhomogeneities on the first motion patterns of P and S waves around force systems simulating an explosition, a unidirectional force, a single couple, and a double couple was also investigated. Two-dimensional ultrasonic modeling techniques were employed. Data for each of the force systems were obtained as a function of azimuth for several cases. E.W.

**N64-14698** Pennsylvania State U., University Park Ionosphere Research Lab.
**THE IONIC STRUCTURE OF THE IONOSPHERE**
W. Swider 15 Dec. 1963 131 p refs
(Contract AF 19(628)-3842; NSF Grant 18983; Contract DASA-WEB-07.010)
(Sci. Rept. 201; AFCRL-63-913; AD-427879)

The derived ionic structure of the daytime ionosphere in the 100 to 300 km region presented shows how detailed ionic observational data can lead to an understanding of the electron density distribution with height. It is shown that the behavior of the nighttime and sunrise ionosphere can be determined to be consistent with the daytime results and the limited number of rocket experimental results describing the nighttime ionosphere. The study shows that such an overall analysis is necessary if explanations for the daytime, nighttime, and twilight 100- to 300-km region are to be congruent. The study also demonstrates that ground-based measurements of electron density are insufficient for an understanding of the physical processes in this region and that ionosonde methods contribute little to knowledge of the nighttime ionosphere. Author

**N64-14711** Joint Publications Research Service, Washington, D.C.
**PECULIARITIES OF THE ATTENUATION OF ENERGY FROM SHALLOW EARTHQUAKE FOCI**
E. M. Demikhovskaya and V. P. Kuznetsov 7 Feb. 1964 13 p refs Transl. into ENGLISH of an article from Dokl. Akad. Nauk Azerb. SSR (Baku), v. 19, no. 4, 1963 p 37–41
(JPRS-23128; OTS-64-21514) OTS: $0.50

Parameters of the waves passing through sedimentary rock were analyzed. The relationship of the change in the wave energy to the epicentral distance was examined. The earthquakes from the Apsheron foci were studied, and the conclusions of the investigation were as follows: (1) The energy of earthquakes from the shallow foci of the Apsheron peninsula is almost completely attenuated at distances of 30 to 40 km. (2) The extinction coefficients of body waves from Apsheron earthquake foci do not remain constant at different epicentral distances. (3) The relationship of energy to magnitude for earthquakes from Apsheron foci can be expressed by the formula log E = 7.5 + 1.8M(J) where E is the energy, J is the energy in joules, and M is the magnitude. R.T.K.

**N64-14719** National Bureau of Standards, Boulder, Colo.
**MEAN ELECTRON DENSITY VARIATIONS OF THE QUIET IONOSPHERE NO. 12, FEBRUARY 1960**
J. W. Wright, L. R. Wescott, and D. J. Brown 6 Dec. 1963 57 p refs
(NBS-TN-40-12) GPO: $0.35

A program has been initiated for large-scale computation of electron density profiles from ionospheric vertical soundings. Scaling is performed at field stations, permitting computation of hourly profiles at the Central Laboratory. These profiles are combined to form hourly mean quiet profiles for each station and month. The results are presented graphically. Author

**N64-14723** Defense Research Board, Ottawa (Canada)
**SUBSECULAR FLUCTUATIONS OF THE LEVEL OF LAKES IN WESTERN SIBERIA AND NORTHERN KAZAKHSTAN, AND THEIR RELATIONSHIP WITH CLIMATIC FLUCTUATIONS**
A. V. Shnitnikov (Acad. Sci. USSR) Jan. 1964 7 p Transl. from Dokl Akad. Nauk SSSR, v. 76, no. 4, 1951, p 523–526
(T-399-R)

The water balance of the steppe lakes of western Siberia and the Kazakhstan regions was studied. Every 15 or 20 years these lakes pass from a stage of partial or complete dryness to a stage of high water and freshening. These fluctuations of water level result in a continual and radical variation of both their physical properties and the physicogeographical characteristics of the whole lacustrine complex. A characteristic feature of the transition of the lakes from low to high water is the rapid, well-marked, and continuous rate of rise of water level continuing for 3 to 5 years after which the rate of rise slows down for the next 4 to 6 years. Then an unsteady maximum period and a protracted uniform decline follow. Analyses are conducted of atmospheric precipitation along with the air temperature in these areas, and the distribution of the meteorological activity in time is indicated. C.L.W.

**N64-14724** Geophysics Corp. of America, Bedford, Mass.
**MASS SPECTROMETER FOR LOWER D-REGION STUDIES**
6 May 1963 92 p refs
(Rept. 883-5-01)

A mass spectrometric investigation of the D-region of the ionosphere is proposed and described along with the accompanying theoretical analysis. The equipment for the measurement of the ionic composition is given first and is followed by a discussion of laboratory tests, calculation of the expected operating range and sensitivity of the equipment, and an analysis of the flight data. The investigation shows that the mass spectroscopic measurement of the ion composition of the D-region is possible but very difficult. C.L.W.

**N64-14828** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**POLAR MAGNETIC DISTURBANCES**
B. E. Brunelli 26 Sep. 1963 47 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 5, 1962 p 801–821
(FTD-MT-63-48/1+2+3+4; AD-429080) OTS: $4.60

This article reviews investigations concerning the process leading to the appearance of polar magnetic disturbances. Two theories are considered—the neutral line theory, describing the processes of invasion of particles, and the dynamo theory, explaining formation of the disturbances that provide a natural explanation of the phenomenon as a whole. It is suggested that both theories be combined and the character of the interaction of both mechanisms be analyzed. C.L.W.

**N64-14842*** Stanford U., Calif. Radioscience Lab.
**ON THE DETERMINATION OF TEMPERATURE AND IONIC COMPOSITION BY ELECTRON BACKSCATTERING FROM THE IONOSPHERE AND MAGNETOSPHERE Scientific Reports Nos. 1 and 7**
D. R. Moorcroft Oct. 1963 39 p refs
(NASA Grant NsG-377; Contract AF19(604)-7436. Supported in part by NSF)
(NASA CR-55434; AFCRL-63-798; SEL-63-125) OTS: $3.60 ph, $1.37 mf

Observations of the scattering of electromagnetic waves from thermal fluctuations in the electron density of the ionosphere and magnetosphere have previously been used to investigate ion and electron temperatures and the electron density. This work was based on the assumptions that the only ions present were $O^+$, and that $kD = 4\pi D/\lambda_T << 1$ ($\lambda_T$ is the transmitted wavelength and D is the Debye length). In this paper, the interpretation of such scattering is extended to conditions likely to apply above the F region, where increasing percentages of $He^+$ and $H^+$ are expected to occur, and where kD may not be very small. Detailed curves are presented for mixtures of $O^+$ and $He^+$. A simple transformation is given that accurately corrects the interpretation for values of kD up to unity. Author

**N64-14848*** Mellon Inst., Pittsburgh, Pa.
**COESITE AND SHOCKED QUARTZ FROM HOLLEFORD CRATER, ONTARIO, CANADA**
T. E. Bunch and Alvin J. Cohen Repr. from Science, Oct. 18, 1963, v. 142, no. 3590, p 379–381 refs Presented at the 1st Western Natl. Meeting of the Am. Geophys. Union, Los Angeles, 27–29 Dec., 1961
(NASA Grant NsG-57-60)

The Holleford Crater, a circular depression in southern Ontario, is filled with Paleozoic sediments and underlain by brecciated Precambrian igneous and metamorphic rocks. The presence of coesite in two core samples of this breccia has been established by petrographic and X-ray diffraction methods. Shattered quartz in the coesite-bearing samples exhibits planar

fractures. The shocked quartz is the result of great shock pressures, and the association of coesite with the shocked quartz strongly suggests that Holleford Crater originated from a hypervelocity impact. Author

**N64-14850*** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**TESSERAL HARMONICS IN THE GEOPOTENTIAL**
Imre G. Izsak (Harvard Coll. Obs.) Repr. from Nature, v. 199, no. 4889 13 Jul. 1963 p 137-139 refs
(NASA Grant NsG 87-60)

Tesseral harmonics coefficients have been computed in different combinations; for example, $C_{22}$ and $S_{22}$ only, or $C_{22}$, $S_{22}$, and $C_{31}$, $S_{31}$, or all 16 of them from the 2nd to the 4th degree. The computed standard errors are unrealistically small, ranging from 3% to 15%. The correlation coefficients of the 22- and 42- terms are extremely high, about 0.85; otherwise a few correlation coefficients are about 0.20, the rest being less than 0.10. In addition, a computer program has been developed to compute, from a set of spherical harmonics coefficients, the level curves of geoid heights and gravity anomalies. A diagram is presented, obtained on an EAI data-plotter, that shows the level curves of satellite-geoid heights at 10-m intervals for the above mentioned tesseral harmonics coefficients. The coefficients of the zonal harmonics are those given by Kozai. I.v.L.

**N64-14869*** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
**EFFECT OF REFRACTION ON THE SETTING SUN AS SEEN FROM SPACE IN THEORY AND OBSERVATION**
Winifred Sawtell Cameron, John H. Glenn, M. Scott Carpenter (NASA. Manned Spacecraft Center), and John A. O'Keefe Repr. from Astron. J. v. 68, no. 5, 1963 p 348-351 refs (Previously published as NASA TN D-1721; see N63-16292 13-12)
(NASA RP-58)

The theory of refraction predicts that the setting sun or moon as seen from space should be highly flattened. The Mercury Project Manned Space Flights MA-6 and MA-7 have provided photographs of the phenomenon. To compare theory with observation for an observer situated outside the atmosphere, an essentially new approach to the refraction problem is employed that is closely related to the theory of refraction height as given by Chauvenet. Theoretical solar profiles for four true zenith distances of the center of the setting sun were constructed, which may be compared to the photographs taken by Glenn and Carpenter. Author

**N64-14876** Joint Publications Research Service, Washington, D.C.
**DETERMINING THE DIRECTION TO THE EPICENTER FROM LOVE AND RAYLEIGH SURFACE WAVES**
Sh. S. Ragimov and N. A. Pavlovskaya 6 Feb. 1964 6 p refs Transl. into ENGLISH of an article from Dokl. Akad. Nauk Azerb. SSR (Baku), v. 19, no. 1, 1963 p 31-32
(JPRS-23115; OTS-64-21504) OTS: $0.50

A discussion is presented of a method for locating portions of seismograms where clear Rayleigh and Love waves appear, in order to determine the azimuth to an epicenter. It is found that the following indices can be used in isolating clear surface waves on seismograms: (1) For Love waves, an absence of oscillations of the vertical component and a coincidence in the arrival times of maxima for the horizontal components are observed. (2) For Rayleigh waves, the recording of the vertical component is always observed, and there is a coincidence, in the arrival time of the displacement maxima for the horizonal components and in the presence of phase displacement that is equal to one fourth of the period between the horizontal and vertical components. P.V.E.

**N64-14879** Joint Publications Research Service, Washington, D.C.
**AEROMAGNETIC SURVEY IN GEOLOGY**
10 Feb. 1964 178 p refs Transl. into ENGLISH of the book "AEROMAGNITNAYA S'EMKA V GEOLOGII" Moscow State Publishing House on Geol. and Mineral Conserv., 1963
(JPRS-23152; OTS-64-21524) OTS: $3.00

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**N64-14905** Pennsylvania State U., University Park. Ionosphere Research Lab.
**THE ANALYSIS OF IONOSPHERIC H'(F) RECORDS USING THE METHOD OF LEAST SQUARES**
D. J. Brown 1 Jan. 1964 52 p refs
(NASA Grant NsG-134-61; NSF Grant G-22040)
(NASA CR-55431; Sci. Rept. 202) OTS: $5.60 ph, $1.76 mf

Electron-density-height profiles in the ionosphere can be obtained from virtual height-frequency records by solving an integral equation. A new method of solution is presented, using an iterative minimization scheme where the independent variable is the true height, h, rather than the plasma frequency, $f_N$. This has the advantage that the method is not restricted to

monotonic functions, $f_N(h)$, and can be used for distributions with a "valley." In addition, other height-varying parameters can be used, such as the gyrofrequency, whose variations with altitude is important for the upper F region, above the electron peak. Author

**N64-14919** Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station
**FURTHER STUDIES OF THE TOPSIDE IONOSPHERE BASED ON THE TOPSIDE SOUNDER SATELLITE DATA**
J. W. King, D. Eccles, P. A. Smith, P. Dannahy, A. Legg et al
Dec. 1963 93 p refs
(RRS/IM 112)

This report presents discussion of the topside ionosphere based on the topside sounder satellite (Alouette) data. Areas included are: (1) the equatorial ionosphere; (2) theoretical electron distributions and their dependence on $T_i$, $T_e/T_i$, and other parameters; (3) major local enhancements of the electron concentration near the peak of the layer; (4) "sheets" of ionization through which the satellite is observed to travel; (5) the boundary of the spread-F region; (6) the problem of oblique echoes; (7) changes that occur in the ionosphere during the night, at sunrise, and at sunset; (8) resonance effects observed on the topside sounder ionograms; and (9) sporadic-E ionization. I.v.L.

**N64-14928*** Alaska U., College Geophysical Inst.
**THE $S_q$ VARIATION AT GEOMAGNETICALLY CONJUGATE AREAS**
E. M. Wescott, R. N. De Witt, and Syun-Ichi Akasofu Repr. from J. Geophys. Res., v. 68, no. 24, 15 Dec. 1963 p 6377-6382 refs
(NASA Grant NsG-201-62; Contract AF 19(628)-2779)

The $S_q$ variation at geomagnetically conjugate areas is examined by use of the San Juan–Trelew pair. It is shown that there is no particular similarity of the $S_q$ variation at the two stations, and the northern and southern foci of the $S_q$ current system are not geomagnetically conjugated. Three important causes of the asymmetric $S_q$ variations are discussed. The asymmetric part of the solenoidal component of the dynamo current could be an immediate cause. The coupling of the northern and southern ionospheres by the geomagnetic field lines tends to exaggerate the effect of the difference in the induced polarization field, rather than to reduce it; further, because of the global scale of the system, the inductance of the circuit may play an important role in skewing the $S_q$ variations. Such a dissimilarity of the $S_q$ variation at the conjugate points is in contrast to a striking similarity of polar magnetic storms at the conjugate points in the northern and southern auroral zones. The dynamo theory of polar magnetic storms is criticized on this basis. Author

**N64-14947** Weapons Research Establishment (Australia)
**IONOSPHERIC DATA FOR JANUARY 1963 FROM WOOMERA, SOUTH AUSTRALIA**
Oct. 1963 24 p
(Ionospheric Data Bull. CPD 1963/1(W))

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for January 1963. Author

**N64-14948** Weapons Research Establishment (Australia)
**IONOSPHERIC DATA FOR FEBRUARY 1963 FROM WOOMERA, SOUTH AUSTRALIA**
Oct. 1963 24 p (For abstract see N64-14947 06-12)
(Ionospheric Data Bull. CPD 1963/2(W))

**N64-14949** Weapons Research Establishment (Australia)
**IONOSPHERIC DATA FOR MARCH 1963 FROM WOOMERA, SOUTH AUSTRALIA**
Oct. 1963 24 p (For abstract see N64-14947 06-12)
(Ionospheric Data Bull. CPD 1963/3(W))

**N64-14950** Weapons Research Establishment (Australia)
**IONOSPHERIC DATA FOR APRIL 1963 FROM WOOMERA, SOUTH AUSTRALIA**
Nov. 1963 24 p (For abstract see N64-14947 06-12)
(Ionospheric Data Bull. CPD 1963/4(W))

**N64-14951** Weapons Research Establishment (Australia)
**IONOSPHERIC DATA FOR MAY 1963 FROM WOOMERA, SOUTH AUSTRALIA**
Nov. 1963 24 p (For abstract see N64-14947 06-12)
(Ionospheric Data Bull. CPD 1963/5(W))

**N64-14972** Pennsylvania State U., University Park
**IONOSPHERIC RESEARCH Final Report, 1 Oct. 1958-31 Oct. 1963**
A. H. Waynick 30 Nov. 1963 52 p refs
(Contract AF 19(604)-4563)
(AFCRL-63-931; AD-428804)

The statement of work for the research to be performed under this contract called for theoretical and experimental investigations on the physics, dynamics, and aeronomic properties of the earth's and other planetary atmospheres. Also involved were theoretical and experimental studies of various relevant atomic and molecular rate coefficients. These broad objectives, along with certain related efforts underway in the laboratory, comprised the basis for the studies outlined in this report. An outline of each investigation undertaken is given. A listing of the reports issued and in preparation is presented. Author

**N64-14984*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE WORLD MAGNETIC SURVEY**
James P. Heppner Washington, NASA, Jan. 1964 45 p refs
(NASA TN D-2109) OTS: $1.25

The mathematical and graphical description of the earth's main field has been, and is, a data-limited problem. The World Magnetic Survey (WMS) is an endeavor to minimize this limitation by rapidly and comprehensively blanketing the earth with magnetic field measurements. Satellite surveys, which will play a key role in the WMS, are the principal topic of this paper. Existing magnetic field descriptions, the expected results from new surveys, and the methods of obtaining these results with the POGO satellite are emphasized. Author

**N64-14998*** Iowa State U., Iowa City
**HIGH-LATITUDE GEOPHYSICAL STUDIES WITH SATELLITE INJUN 3. 5. VERY-LOW-FREQUENCY ELECTROMAGNETIC RADIATION**
D. A. Gurnett and B. J. O'Brien Repr. from J. Geophys. Res., v. 69, no. 1, 1 Jan. 1964 p 65-89 refs
(NASA Grant NsG-233-62)

It is found that the amplitude of naturally occurring VLF signals is commonly tens of decibels stronger at Injun 3 than on the ground, and this is to be understood as due to strong absorption of VLF energy in the ionosphere, as has been found previously in other experiments. The maximum observed signal strength over the band 0.5 to 7.0 kc is $5 \times 10^{-2}$ gamma. The

amplitude of VLF chorus, considered for local times between 0800 and 1300, shows a maximum at $L = 5$ over the 3-day period studied. Simultaneous occurrences of VLF electromagnetic emission, auroral optical emissions, and particle precipitation into the atmosphere have been repeatedly observed. Two specific instances are discussed. In the more stable of the two, it is concluded that the auroral hiss was generated in the same magnetic shell in much the same region of the magnetosphere (near the outer boundary of trapping) as were the precipitated particles that caused the aurora. Author

**N64-14999*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE INFRARED HORIZON OF THE PLANET EARTH**
R. A. Hanel, W. R. Bandeen and B. J. Conrath Repr. from J. Atmospheric Sci., v. 20, no. 2, Mar. 1963, p 73–86 refs (See N63-20603 20-12)

Horizon sensors are essential elements in the orientation systems of many space vehicles and satellites. Their design and an evaluation of their capabilities and limitations require a knowledge of the spectral radiance emitted by the earth. This report investigates the discontinuity between the surface, the atmosphere, and outer space for various latitudinal, seasonal, climatic, and meteorological conditions. Calculations are carried out for the following five spectral intervals—the water vapor band from 6.33$\mu$ to 6.85$\mu$, the ozone band from 8.9$\mu$ to 10.1$\mu$, the atmospheric window from 10.75$\mu$, the carbon dioxide band from 14$\mu$ to 16$\mu$, and finally the rotational water vapor band from 21$\mu$ to 125$\mu$. The superior properties of the carbon dioxide band and the rotational water vapor region for horizon sensor purposes are shown. Author

# 13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

**N64-14263*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**HEAT-TRANSFER ASPECTS OF SPACE RADIATORS**
Seymour Lieblein [1963] 18 p refs Presented at the AICHE/ASME 6th Natl. Heat Transfer Conf., Boston, Mass., 11–14 Aug. 1963
(NASA TM X-51129; Lewis TP-5-63) OTS: $1.60 ph, $0.80 mf

Thermal radiators are required for closed-cycle space powerplants to dissipate cycle waste heat. The basic problem is to provide for the removal of this heat in compact, lightweight components of high reliability. Space power cycles requiring waste-heat radiators are discussed, and heat-removal systems and radiator characteristics are described. The basic heat-transfer paths from working fluid to radiator outer surface are traced, and recent developments in these areas are presented. First, internal fluid heat-transfer coefficients in liquid-metal- and gas-filled tubes are discussed. The second consideration involves the two-dimensional conductive heat transfer through the tube and fin cross section. For the third path of net emission from the radiator surface, such factors as the effects of tapered fins, various fin-tube geometries, and meteoroid bumpers are considered. Author

**N64-14283*** National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
**A NEW STEADY STATE CALORIMETER FOR MEASURING HEAT TRANSFER THROUGH CRYOGENIC INSULATION**
R. H. Kropschot, David R. Beck, and Frank Kreith (Colo. U.) Presented at the 1963 Cryogenic Eng. Conf., Boulder, Colo., Aug. 19–21 17 p refs
(NASA Order R-45)
(NASA CR-55327; NBS-R-294) OTS: $1.60 ph, $0.80 mf

A guarded cylindrical calorimeter, using evaporation techniques for heat flux measurements, is described. The apparatus can be used to measure the thermal conductivity of the same, undisturbed sample over wide temperature limits to an accuracy of better than 3 percent. The conductivity of one sample of $SiO_2$ plus aluminum powder is reported. Author

**N64-14296** RAND Corp., Santa Monica, Calif.
**HEAT EXCHANGE WITH A FLOW OF A RAREFIED GAS ALONG A WALL [TEPLOOBMEN OBTEKKANIEM RAZREZHENNOGO GAZA SO STENKOL]**
A. A. Pomerantsev Nov 1962 24 p refs Transl. into ENGLISH from Inzhenerno-Fiz. Zhur. (Minsk), v. 3, no. 5, 1960 p 3–11
(Contract AF 49(638)-700; Proj. RAND)
(RM-3016-PR; AD-291717)

The Blasius–Rubesin method is generalized for the case of supersonic movement of a body in a rarefied gas in the presence of slip. A solution is obtained for the flow of gas along a wall. A conclusion is deduced for hydrodynamic and thermal boundary conditions. Author

**N64-14370** Northwestern U., Evanston, Ill.
**PARTITION FUNCTIONS AND THERMODYNAMIC PROPERTIES OF HIGH TEMPERATURE GASES**
Kenneth S. Drellishak Arnold Air Force Station, Tenn. Arnold Engineering Develop. Center, Jan. 1964 160 p refs
(Contract AF 40(600)-972)
(AEDC-TDR-64-22, AD-428210)

Assuming a mixture of perfect gases consisting of atoms, molecules (neutral and singly ionized), negative atomic ions, electrons, and up to four positive atomic ions, the equilibrium composition, internal partition functions, and thermodynamic properties of argon, nitrogen, and oxygen plasma were calculated by the methods of statistical mechanics for six pressures (0.01, 0.1, 0.5, 1.0, 2.0, and 5.0 atm) at 100° K increments for temperatures up to 35,000° K. Tables and figures include internal partition functions for all heavy species, chemical composition, mass density, entropy, internal energy, enthalpy, Gibb's and Helmholtz free energies, specific heats at constant pressure and volume, the effective gamma, and equilibrium sound speed. Author

**N64-14379** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**EXPERIMENTAL INVESTIGATION OF THE HEAT EXCHANGE OF HEATED BODIES IN A FLOW OF GAS DURING NON-EQUILIBRIUM EXOTHERMAL CHEMICAL REACTIONS**
Yu. N. Petrov, S. F. Evlanov, and N. M. Bolbit 28 Oct. 1963 14 p refs Transl. into ENGLISH from the publ. "Fiz. Gazodinam. Teploobmen i Termodinam. Gazof. Vysokikh Temperatur", Moscow, Izd. AN SSSR, 1962 p 188–193
(FTD-MT-63-95/1+2+3+4; AD-428556) OTS: $1.60

Experiments were conducted on models of the following types: (1) a transversely streamlined platinum filament heated by an electric current, (2) a transversely streamlined circular cylinder made of a thermal insulating ceramic material heated by an electric current, and (3) a longitudinally streamlined plate with heating elements in a line. R.T.K.

**N64-14471** Borden Chemical Co., Philadelphia, Pa.
**STUDY LEADING TO THE DEVELOPMENT OF REINFORCED HIGH TEMPERATURE ELASTOMERS Quarterly Progress Report No. 3, 1 Apr.-30 Jun. 1963**
K. C. Tsou, R. N. Goldey, and B. D. Halpern [1963] 46 p refs
(Contract DA-36-034-AMC-3791-W)
(AD-428792) OTS: $4.60

The use of certain grades of fibrous talc has been found to improve the high temperature tensile strength of silicone rubbers, when used with modified or unmodified silica. The improvement has been due to both the fibrous nature of the talc and the heat-stabilizing effect of the iron oxide present in talc. Optimum loading concentration has been determined. Modification of the fibrous talc by chlorosilanes has been successful, and the use of such modified talc and trimethylsilyl-modified silica improves high tensile strength of rubber on aging at 500° F. When a filler modified with trimethylchlorosilane and vinylchlorosilane was used, the elongation at high temperature was improved. Author

**N64-14480** General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
**HIGH TEMPERATURE EMISSIVITIES AND INTENSITIES OF THE 1.87$\mu$ BAND OF $H_2O$ BETWEEN 1000°K AND 2200°K**
C. C. Ferriso, C. B. Ludwig, and C. N. Abeyta Nov. 1963 22 p refs
(Contract AF 19(628)-3269; ARPA Order AD-363; Proj. Defender)
(GDA63-1219; AD-428798)

Spectral emissivities of the 1.87$\mu$ ($\nu_2 + \nu_3$) combination band of $H_2O$ from 4300 $cm^{-1}$ to 600 $cm^{-1}$ have been measured between 1000° and 2200° K. The heated $H_2O$ test gas was produced at the exit of a small supersonic burner which used $H_2$ and $O_2$ propellants. The emission measurements of the gases were made at the immediate exit of the burner where the composition, total pressures, and temperature can be defined. The emissivities or absorptivities were calculated from a calibrated emission spectrum and an accurate spectroscopic determination of the temperature of the test gas. The composition of $H_2O$ was evaluated from a semi-empirical fit to a thermochemical flow calculation. Author

**N64-14518** Massachusetts Inst. of Tech., Cambridge
**FILM BOILING ON THE INSIDE OF VERTICAL TUBES WITH UPWARD FLOW OF THE FLUID AT LOW QUALITIES**
Richard S. Dougall and Warren M. Rohsenow Sep. 1963 114 p refs
(NSF Grant 21455)
(MIT-TR-9079-26)

Flow regimes, local heat-transfer coefficients, and temperature distributions along the wall have been studied for film boiling inside a vertical tube with upward flow of a saturated liquid. The area of interest has been limited to cases of constant heat flux from the tube wall, small inlet liquid velocities, and film boiling which completely covers the entire heated portion of the tube. A visual test section made of electrically conducting glass tubing has been used for flow visualization studies at low qualities. Visual observations with this test section have indicated that the flow regime is annular with liquid in the center and vapor along the walls of the tube. Based on interpretations of temperature distribution data, it has been concluded that the annular flow regime changes at higher qualities to one of dispersed flow—where the liquid is dispersed in the form of drops through a predominantly vapor flow. Author

**N64-14628** Hercules Powder Co., Cumberland, Md.
**AERODYNAMIC HEATING AND STRUCTURAL RESPONSE**
Stanley C. Browning Jul. 1963 68 p refs
(Contract NOrd-16640)
(ABL/EPA-11; AD-428616) OTS: $6.60

A simplified method for determining the aerodynamic heating that occurs on vehicles traveling at high speeds is presented. Relations are submitted that permit the calculation of the temperature of the boundary layer and the heat-transfer coefficient as a function of Mach number and altitude. Both laminar and turbulent flow within the boundary layer are considered, and the method has been programed for use with automatic digital computation equipment. Equations for predicting structural temperatures resulting from aerodynamic heating are also presented and are incorporated into the overall program in order that the effects of surface temperature on the aerodynamic heat input can be taken into account. Author

**N64-14657** Solar, San Diego, Calif.
**DEVELOPMENT OF MANUFACTURING METHODS FOR LIGHTWEIGHT METAL FOIL HEAT EXCHANGERS Sixth Interim Technical Report [18 Sep.-17 Dec. 1963]**
J. P. Boland, L. A. Schlagel, and W. A. Compton 10 Jan. 1964 73 p refs
(Contract AF 33(657)-8766)
(ER-1245-8; AD-427224)

The principal effort was concerned with the development of fabrication techniques for the construction of metal foil heat exchangers. The experimental work included: forming, joining, and testing of the high-temperature precooler; forming, joining, and coating of the refractory metal pre-precooler; and forming and joining of the low-temperature precooler. Author

**N64-14679** General Electric Co., King of Prussia, Pa. Space Sciences Lab.
**THEORETICAL ANALYSIS FOR THE MECHANICAL SPALLATION OF A TYPICAL CHARRING ABLATOR DURING REENTRY**
R. D. Mathieu Dec. 1963 42 p refs
(Contract AF 04(694)-222)
(R63SD53; AD-428046)

Results are presented for the transient ablation performance of a typical charring ablator for which char is removed by spallation. The mechanism for the spallation process depends upon the internal stress due to the gas pressure drop through the char and a critical char thickness, which is related to the surface shear stress. The environmental conditions considered are representative of a ballistic reentry trajectory. Detailed calculations of the temperature, gas pressure, material density, porosity, and stress distribution through the material are presented. The effect of the char porosity on the internal stress is shown. In addition, results that demonstrate the effects of increased heating on the char removal and overall ablation performance are presented. Author

**N64-14817** Martin Co., Orlando, Fla. Aerosciences Research Lab.
**TWO DIMENSIONAL ANALYSIS OF TRANSIENT HEAT CONDUCTION IN A SECTOR OF A HOLLOW CIRCULAR CYLINDER [Final Report, Jan.-Aug. 1963]**
J. G. Torian and G. K. Bennett Wright-Patterson AFB, Ohio. AF Flight Dyn. Lab., Nov. 1963 139 p refs
(Contract AF 33(657)-10315)
(OR-3351; ASD-TDR-63-642; AD-429077) OTS: $11.00

This study was undertaken to develop an exact mathematical formulation of transient heat conduction to reduce the amount of idealization required by currently employed finite-difference techniques. A two-dimensional analysis is developed beginning with the differential equations for conduction of heat in a segment of a hollow cylinder in polar coordinates. An exact solution with constant thermal diffusivity and conditions of prescribed surface temperature, convection, and direct heat input is written in an infinite series of Bessel and trigonometric functions. Provisions are made for incorporating a coordinate varying, arbitrary, initial temperature distribution as well as coordinate and time varying arbitrary surface conditions. A solution that incorporates the effect of temperature dependent thermophysical properties is developed by combining the exact solution with a finite-difference approach. The solution has been programed for an IBM 7090 or 7094 digital computer. Author

**N64-14823** Aerojet-General Corp., Azusa, Calif. Structural Materials Div.
**NON-EVACUATED CRYOGENIC INSULATION [First Quarterly Report, 14 Jun.-15 Sep. 1963]**
C. L. Johnson and D. J. Hollweger Oct. 1963 50 p refs
(Contract AF 33(657)-11200)
(Rept. 0782-01-1; AD-429089)

The results of a survey of the technical literature for information concerning the behavior of porous insulating media suitable for cryogenic service are presented, with special attention given to heat-transfer characteristics in the transitional pressure range between free-molecular and viscous flow. Conditions governing the design of nonevacuated, high-efficiency, porous cryogenic insulation are discussed, and a hypothetical model is advanced as an aid in predicting thermal conductivities of potential insulating materials. The concept of agglomeration of submicron particles in the 80A size range and its effect upon insulation values is discussed. Several suggestions are made for substantially decreasing gaseous conductivity by control of the interstitial gas pressure. Author

**N64-14847*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**ANALYSIS OF MOVEABLE LOUVERS FOR TEMPERATURE CONTROL**
Joseph A. Plamondon 1 Jan. 1964 17 p refs
(NASA Contract NAS7-100)
(NASA CR-53046; JPL-TR-32-555) OTS: $1.60 ph, $0.80 mf

The thermal performance of louvers, along with the controlling parameters, was analyzed, and seven equations describing the thermal behavior of a louver array were derived. Six of the equations, forming a simultaneous set consisting of three linear integral equations and three linear algebraic equations, describe the heat-transfer characteristics of an array. The seventh gives the relative thermal performance of an array in terms of effective emissivity. The equations are solved numerically, and effective emissivity is plotted as a function of louver blade position for various values of the dimensionless parameters that appear in the governing heat-transfer equations. The results are compared with experimental results obtained for the Mariner 2 spacecraft louver system. Author

**N64-14852** Itek Corp., Palo Alto, Calif. Vidya Div.
**ANALYTICAL EVALUATION OF ROCKET NOZZLE ABLATION**
Robert M. Kendall and Ronald A. Rindal N.Y., Am. Inst. of Aeron. and Astron. [1964] 16 p refs Presented at the AIAA Solid Propellant Rocket Conf., Palo Alto, Calif., 29-31 Jan. 1964 Work performed under subcontract for Thiokol Chem. Corp.
(Contract AF 33(600)-36514)
(AIAA Paper 64-101) AIAA: $0.50 members, $1.00 nonmembers

A generalized method is presented for calculating the rates of material ablation. The surface elemental and energy conservational relations permit evaluation of the effects of unequal effective binary diffusion coefficients, arbitrary rates of condensed phase mass addition and removal, and transient rates of char and resin consumption. The relations required for the calculation of the surface state, under conditions of both equilibrium and heterogeneous chemical reaction rate control, are presented. In addition, a method for including the effects of gas-phase chemical reaction rate control within the boundary layer is described. The solution of the equations presented is demonstrated by employing the simplifying assumptions of chemical equilibrium and a unity boundary-layer Lewis number. A comparison of predicted and measured ablation rates in two solid-propellant graphite rocket nozzle throats leads to the conclusion that chemical kinetics, both in the gas stream and at the surface, are important. I.v.L.

**N64-14855*** California Inst. of Tech., Pasadena
**THE STRUCTURAL INTEGRITY OF AN ABLATING ROCKET SUBJECTED TO AXIAL ACCELERATION**
G. H. Lindsey and M. L. Williams N.Y., Am. Inst. of Aeron. and Astron. [1964] 8 p refs Presented at the AIAA Solid Propellant Rocket Conf., Palo Alto, Calif., 29-31 Jan. 1964
(NASA Grant NsG-172-60)
(AIAA Paper 64-151) AIAA: $0.50 members, $1.00 nonmembers

The purpose of this report is to indicate the type of viscoelastic analysis that is involved in conducting a structural integrity study of an axially accelerated rocket. A case bonded, long circular port grain will be assumed, and the effect of an ablating boundary, which allows for a decreasing weight with time, will be included in the analysis. Therefore the constant burning rate will enter as a design parameter. The essential feature of the analysis is that the stress in the grain is proportional to $n\rho gb$, the strain to $n\rho gbD$, and the displacement to $n\rho gb^2D$, where $\rho g$ is the weight density of the propellant, b is the outside radius, and D is the compliance. For a step function loading, the time-dependent slump deformations may be predicted, without formal viscoelastic analysis, by using the creep compliance D(t) as measured in a tensile test. Also, in order to illustrate how design envelopes may be constructed, a failure criterion is assumed, and representative results are obtained, showing how the design parameters of web fraction, burning rate, and inertia factors interact with the rocket size. I.v.L.

**N64-14979** RAND Corp., Santa Monica, Calif.
**THE THERMODYNAMICS OF THE PHENOL-FORMALDEHYDE RESIN: CARBON-HYDROGEN-OXYGEN VAPOR SYSTEM**
F. J. Krieger Jan. 1964 35 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3988-PR; AD-428583)

The purpose of this study is the thermodynamic investigation of phenol-formaldehyde resin over a range of temperatures up to 6000° K and pressures up to $10^5$ atmospheres. Two sets of equilibrium composition equations are used, one representing a pure gas phase, the other a heterogeneous system of gas and solid carbon. The gas phase of the heterogeneous chemical system, like the homogeneous gas phase, comprises 73 gaseous carbon-hydrogen-oxygen species. The results of the computational program are presented in both tabular and graphic form. The latter is a conventional Mollier diagram in which specific enthalpy is plotted against specific entropy, with cross plots of temperature, pressure, and molecular weight. Author

**N64-14985*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**EVALUATION OF SHOCK-TUBE HEAT-TRANSFER EXPERIMENTS TO MEASURE THERMAL CONDUCTIVITY OF ARGON FROM 700° TO 8600° K**
Milton R. Lauver Washington, NASA, Feb. 1964 20 p refs
(NASA TN D-2117) OTS: $0.50

Recent studies of heat transfer to a solid from a hot stagnant gas behind reflected shock waves have been interpreted to obtain the thermal conductivity of the gas or its integral with respect to temperature. The interpretations are critically compared with each other and with new experimental data from argon shock-heated to 8,580° K. The surface temperature rise of heat-resisting plate glass suddenly exposed to hot argon was predicted and experimentally verified to the limits of the test. Variations of several percent in the theoretical, assumed thermal-conductivity values of argon had little effect on the temperatures predicted. Within these limits, theoretical values of thermal conductivity for argon were experimentally verified. Author

**N64-14992** Atomics International, Canoga Park, Calif.
**THERMAL PROPERTIES OF REFRACTORY MATERIALS**
R. E. Taylor and M. M. Nakata Wright-Patterson AFB, Ohio, AF Materials Lab., Nov. 1963 119 p refs
(Contract AF 33(657)-7136)
(WADD TR 60-581, Pt. 4; AD-428669)

A new technique for the measurement of the thermal diffusivity at high temperatures is described. The diffusivity is determined from the time interval separating two radial isotherms in a cylindrical specimen. The observations are made during the transient heating (or cooling) period, using a sensitive photoelectric pyrometer developed for the purpose. Measurements are reported on Armco iron, Ta, W, TiC, ZrC, HfC, and TaC. Thermal conductivity results on certain refractory materials, previously reported by other laboratories, were not believed to be valid. Data were obtained on TiC, TiN, and ZrC, in order to check the previous results and to provide internal standards for testing the new thermal diffusivity technique. Work on the thermal expansion and specific heat of various refractory materials is also described. Author

# 14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

**N64-14423** North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
**SPACECREW SELECTION AND TRAINING, A SURVEY [OF LITERATURE, 1957-1963]**
14 Jun. 1963 37 p refs
(SID-63-707)

Literature, from 1957 to the present, on selecting and training personnel for orbital and space flight is surveyed. Although most of the references are to American publications, a special effort has been made to include all Soviet material so far released to the West. Author

**N64-14469** Information International, Inc., Maynard, Mass.
**INVESTIGATION INTO THE SPECIAL PROGRAMMING NEEDS FOR AN AUTOMATED LABORATORY FOR PSYCHOLOGICAL RESEARCH**
Edward Fredkin Bedford, Mass., Decision Sci. Lab., 30 May 1963 50 p refs
(Contract AF 19(628)-1662)
(ESD-TDR-63-353; AD-427103)

This report contains a summary of studies evaluating the relative importance to an automated psychological laboratory and the feasibility of the following: (1) development of a statistical package for real-time data analysis to permit modifications of an on-going experiment; (2) development of a statistical package for conventional data analysis and display; (3) using a computer as a teaching machine to prepare subjects for experiments; (4) using a computer to train programers and experimenters; and (5) using a computer to investigate the strategy of experimentation, e.g., simulation of subjects to allow exploration of experimental design. Author

**N64-14519*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**MINIMUM CREW SPACE HABITABILITY FOR THE LUNAR MISSION**
George A. Rathert, Jr., Norman M. Mc Fadden, Richard F. Weick, R. Mark Patton, Glen W. Stinnett et al Washington, NASA, Feb. 1964 64 p refs
(NASA TN D-2065) OTS: $1.75

Two experienced and highly motivated test subjects, an NASA test pilot and a physiologist, performed a 4-hour-on, 4-hour-off work schedule for 7 days in a capsule providing 61.5 cubic feet per man. The purpose was to consider the feasibility of reducing the booster requirements for the lunar mission by using only a two-man crew and a small capsule. The subjects performed a work schedule comprised of engineering, psychological and physiological monitoring, and research tasks. The effects of the stresses produced by the small size of the work space and by the work schedule were studied. The ecological system was not closed and a "shirt sleeve" environment was provided. No phenomena were encountered that would preclude the use of a small capsule and a 7-day mission. Both subjects sustained expected levels of performance throughout the test and were in condition to continue at its conclusion. Author

# 15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

**N64-14655*** National Aeronautics and Space Administration, Washington, D.C.
**MANNED SPACE FLIGHT TEAM**
Oct. 1963 15 p
(NASA EP-11) GPO: $0.15

Resumes of the following members of the manned spaceflight team are presented: (1) Neil A. Armstrong; (2) Frank Borman; (3) M. Scott Carpenter; (4) Charles Conrad, Jr.; (5) L. Gordon Cooper, Jr.; (6) John H. Glenn, Jr.; (7) Virgil I. Grissom; (8) James A. Lovell, Jr.; (9) James A. McDivitt; (10) Walter M. Schirra, Jr.; (11) Elliot M. See, Jr.; (12) Alan B. Shepard, Jr.; (13) Donald K. Slayton; (14) Thomas P. Stafford; (15) Edward H. White; and (16) John W. Young. Also, a list of the 14 newest astronauts is presented, and the training program for the flight personnel of the Manned Space Center is discussed. I.v.L.

**N64-14778** Naval School of Aviation Medicine, Pensacola, Fla.
**THE WOLFF-PARKINSON-WHITE SYNDROME AS AN AVIATION RISK**
Raphael F. Smith 28 May 1963 15 p refs
(Rept. 15; AD-428966) OTS: $1.60

The prevalence of the W–P–W anomaly, the prevalence of tachycardia in the W–P–W group, and the incidence of tachycardia during the period of observation have been calculated from data obtained from surveys conducted on four groups of normal people. The mortality rate and the morbidity associated with the W–P–W syndrome are discussed. From observations on these groups of subjects and from similar observations reported in the medical literature the conclusion is reached that asymptomatic aviators and aviation candidates with the W–P–W anomaly could be allowed to continue in an unrestricted flying status, but those with paroxysmal tachycardia should be permanently disqualified for duty involving the actual control of aircraft. Author

**N64-14943** Martin Co., Baltimore, Md.
**A MODEL OF HUMAN MAINTENANCE BEHAVIOR, I. DEVELOPMENT OF THE PROBLEM AND EVIDENCE FOR A MODEL**
Hilton A. Grodsky, Girard W. Levy, and Robert D. Sorkin [1962] 24 p refs
(Eng. Rept. 11133)

This paper is concerned with the important facets of human maintenance behavior in space travel and the existence of evidence to suggest a model for human maintenance behavior. The need to develop a theoretical model of human maintenance behavior, to be utilized in the training of personnel and in the design of equipment so as to realistically achieve the financial benefits of a reduced payload weight, is indicated. This model utilizes elements of signal detection theory and game theory. An example of a simple maintenance situation is given indicating some of the complex problems in its development and the derived benefits. C.L.W.

**N64-14997** Sandia Lab., Albuquerque, N. Mex.
**VISUAL AIDS FOR MANUFACTURING PERSONNEL**
Joseph Crompton Feb. 1964 17 p
(SC-4959(M)) OTS: $0.50

This report presents the simplified techniques used at Sandia Corporation in developing visual aids for weapon rebuild operations. However, these simplified techniques also have broader applications and can be used wherever complicated relationships must be translated into shop language. Author

**N64-14272*** National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab. Div.
**CARBON RESISTORS FOR CRYOGENIC LIQUID LEVEL MEASUREMENT**
Richard C. Muhlenhaupt and Peter Smelser 9 Oct. 1963 31 p ref
(NASA Order R-45)
(NASA CR-55333; NBS-TN-200) OTS: $3.60 ph, $1.13 mf

Tests in liquid nitrogen, hydrogen, and helium were conducted on a number of 0.1-watt and 0.5-watt carbon composition resistors having nominal resistances ranging from 10 to 10,000 ohms. Data are shown in graphical form. One set of plots presents resistance ratio $R_G/R_L$ as a function of "warming up" time at various levels of constant power dissipation. A second set of plots presents resistance ratio $R_L/R_O$ as a function of nominal resistance at various levels of constant power dissipation. The use of the data and the design of a practical liquid level indicator are discussed in the appendix. Author

**N64-14300** Naval Ordnance Lab., White Oak, Md.
**AN INCREMENTAL HYDROBAROPHONE**
Edward L. Peters and Charles H. Marshall 27 Feb. 1963 97 p
(NOLTR 62-174; AD-407583)

A Wein bridge-type hydrobarophone capable of measuring incremental pressure fluctuations as low as 1/10 of an inch of water in the presence of a static head as high as 300 feet of water is described. A frequency response of 0 to 200 cps is attainable. Special features include an incremental pressure sensitivity independent of static head, enclosure of the hydrobarophone in a fiberglass container to shield it from undesirable temperature changes, and an attached temperature indicator. An acoustic filter inserted between the pressure equalization system and the active portion of the hydrobarophone permits pass band operation. The low frequency end of the band can be easily adjusted for any desired period less than an hour. Author

**N64-14350** Page Communications Engineers, Inc., Washington, D.C.
**SPACE COMMUNICATIONS TECHNIQUES**
Rodney C. Pratt Griffiss AFB, N.Y., RADC, Advanced Develop. Lab. Dec. 1963 33p refs (See N63-15696 12-08)
(Contract AF 30(602)-2403)
(RADC-TDR-63-611, Suppl. 1; AD-428380) OTS: $3.60

This report describes modification and completion of instrumentation for use in communications experiments with passive satellites. Boresighting instrumentation was installed and modifications for optical viewing were made to a 60-foot antenna reflector. The cassegrain subreflector for the Trinidad site antenna was rebuilt and tested. Instrumentation for pulse operation at the communications frequency at the Trinidad site was completed with the installation of a duplexer and a receiver protector. Author

**N64-14412** Atomic Energy Commission, Idaho Falls, Idaho National Reactor Testing Station
**MANUAL FOR OPERATIONAL DOCUMENTARY PHOTOGRAPHY (ODP)**
V. V. Hendrix 23 Dec. 1963 25 p
(IDO-10037, Rev. 1) OTS: $0.50

This program provides for complete and detailed photographic coverage of all facilities at the nuclear-reactor test site involving reactor operation, fuel storage, or fuel processing. Discussed are: (1) indexing and coding of photographic data; (2) operational planning for documentary photographs; (3) plan of operation; (4) the distribution of aperture card decks; and (5) the method of updating cards. This system of documentary photographic coverage provides information concerning the safety characteristics of all reactors operating, as well as a basis for the accumulation of vital data to aid in rescue or recovery operations in the event of any type of a disaster occurring at the nuclear-reactor test site. I.v.L.

**N64-14417** Kitt Peak National Observatory, Tucson, Ariz.
**Monthly Report, November 1963 [ACTIVITIES OF THE STELLAR, SOLAR AND SPACE DIVISIONS]**
[1963] 10 p

The current program status includes: (1) The 36-in. telescope was used on 23 nights for 167 hours (51% of the available night hours). (2) Testing of the primary mirror support system of the 84-in. telescope is continuing. (3) The Hartmann reduction program has been translated into the new assembler language, and a line printer output has been added. (4) Four new designs have been submitted for all-spherical field corrector systems with an f/2.8 Ritchey-Chretien primary. (5) The design of auxiliary equipment for the vacuum spectrograph to permit the measurement of solar magnetic fields is complete. (6) A technique was tried in which digital data from the solar spectrograph were averaged by use of the CDC 160A computer in order to improve the signal-to-noise ratio. (7) An Aerobee flight at the White Sands Missile Range has been scheduled for the evening of April 7, 1964, to measure the polarization and intensity of the zodiacal light at five wavelengths ranging from 3500 to 10,000 A. I.v.L.

**N64-14443** Aeronautical Research Labs., Melbourne (Australia)
**TRANSONIC WIND TUNNEL MEASUREMENTS OF THE PERFORMANCE OF A HEMISPHERICAL-HEAD INCIDENCE-METER**
D. A. Secomb Aug. 1963 50 p refs
(ARL/Aero-223)

The performance of a hemispherical-headed incidence meter (probe) has been measured over the Mach number range 0.5 to 1.3 at flow angles up to 25°. The pressures at pitot and static pressure holes in the probe were also measured. The investigation was aimed at finding the effect of variation of the probe free length when mounted on a body with an ogive nose. The probe diameter was 7.5% of the body diameter. Measurements were made for free length–diameter ratios of the probe of 13.4, 7.0, and 3.1. The results showed that decrease of probe free length to 7.0 probe diameters caused no loss of incidence sensitivity. At a free length of 3.1 probe diameters, a loss of sensitivity of about 10% was found at subsonic speeds. The sensitivity at supersonic speeds was unchanged. Author

**N64-14635** Navy Electronics Lab., San Diego, Calif.
**DIRECTIVITY FACTOR COMPUTER FOR ELECTROACOUSTIC TRANSDUCERS Research and Development Report, Mar.–Oct. 1962**
C. E. Green and J. R. Roshon 13 Sep. 1963 32 p refs
(NEL-1196; AD-428284)

The directivity factor computer (DFC) is described. A direct current is modified electrically in correspondence with the variations in the pressure level of the transducer; at the same time, an equal area sampling is obtained for varying orientations. The d.c. output is converted to a proportional frequency, and all cycles are counted to provide a measure of the integrated power radiated by the transducer referenced to an equivalent sphere of 2-meter diameter. Author

**N64-14659** Massachusetts Inst. of Tech., Cambridge Aerophysics Lab.
**FURTHER EVALUATION OF A MAGNETIC SUSPENSION AND BALANCE SYSTEM FOR APPLICATION TO WIND TUNNELS**
Eugene E. Covert and Edward Lee Tilton III Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Dec. 1963 83 p refs
(Contract AF 33(616)-7023)
(ARL-63-226; AD-427810)

The application of a magnetic suspension and balance system to static and dynamic wind-tunnel testing is discussed. The equipment and experiments are described, and an analysis of the performance of the system is given. Author

**N64-14669** Aerospace Corp., El Segundo, Calif. Labs. Div.
**ERRORS IN THE CALIBRATION OF RADIANCE RADIOMETERS**
R. D. Rawcliffe 21 Nov. 1963 23 p
(Contract AF 04(695)-269)
(SSD-TDR-63-310; TDR-269(4260-10)-1; AD-428068)

A procedure has been developed which can be used to correct for an error commonly encountered in the calibration of radiometers. If a radiometer designed for radiance determination is calibrated by means of a small source, loss of light due to imperfections in the optics can cause the radiometer to appear less sensitive than it actually is. Measurement of the angular response function provides a means for eliminating this error. Author

**N64-14736** Union Carbide Nuclear Co., Oak Ridge, Tennessee
**AN INEXPENSIVE AUTOMATIC RECORDING BALANCE**
J. Farquharson 3 Feb. 1964 13 p refs
(Contract W-7405-eng-26)
(K-1593) OTS: $0.50

This report describes a method of inexpensively converting a commercial beam-type chain-weight analytical balance for automatic recording operation. In this null-type instrument, beam unbalance is detected by a photoelectric device. The restoring force is obtained by the action of a simple electronic servosystem on the chain weight. Readout may be graphic or digital or both. The range, without manual manipulation, of weights, is 100 mg. Author

**N64-14761** Bell Helicopter Co., Fort Worth, Tex.
**DEVELOPMENT OF A SUBMINIATURE SURFACE MOUNTED PRESSURE TRANSDUCER Summary Report**
F. Burpo Jan. 1963 78 p refs
(Contract Nonr-2877(00))
(Rept. 299-099-200; AD-297483)

The results of the development work and tests indicate that the subminiature pressure transducers are suitable for measuring air loads on helicopter rotors as well as in laboratory, wind tunnel, and other flight test work. These new gages

measure absolute pressure, may use a.c. or d.c. excitation, are surface mounted, and require no structural modification for installation. Author

**N64-14770** Electro-Mechanics Co., Austin, Tex.
**STABILIZATION OF THE VARIABLE-MU MAGNETOMETER Final Engineering Report 1, 31 Mar. 1960-31 Mar. 1963**
F. J. Morris and W. E. A. Rusko 30 Jun. 1963 25 p refs
(Contract AF 19(604)-5520)
(AFCRL-63-939(1); AD-428841)

The basic principle is described, and a brief description of the electronic circuitry used in these instruments is given. Several methods of stabilization are mentioned. Two three-component, orthogonally placed sensors and related electronics systems were built using these techniques and were field tested. The characteristics of these instruments are discussed, methods of stabilization are compared, and conclusions are given. Author

**N64-14792** Tavco, Inc., Santa Monica, Calif.
**QUALIFICATION TEST REPORT TAVCO P/N 2144324, PRESSURE SWITCH TO TEST REPORT NO. 56-104 TAVCO P/N 214432, PRESSURE SWITCH**
C. F. Batte 4 Jun. 1963 87 p refs
(Rept. 63-104; AD-428559)

A qualification test report is given to show that a similarity exists between the TAVCO P/N 2144324 pressure switch and the P/N 214432 pressure switch. Both are piston-type spring operated units with dynamic "O" ring seals. All aluminum alloy parts are 2024T4 aluminum alloy, anodized per Mil-A-8625. Springs are music wire, plated per Mil-T-10727, and the units operate on air or Mil-O-5606 hydraulic oil. The specimen is subjected to the following tests: examination of product, proof pressure test, operation, endurance, burst, and vibration. The specimen is carefully inspected to determine the conformance with the requirements for material, workmanship, dimensions, and markings. The units are successfully tested, satisfactorily meet all requirements, and are considered acceptable for qualification approval. C.L.W.

**N64-14829** Technical Operations, Inc., Burlington, Mass.
**EFFECTS OF HYPERVELOCITY IMPACTS ON MATERIALS Eighth Quarterly Progress Report, 12 Jun.-12 Sep. 1963**
V. E. Scherrer, H. Stevens, and R. W. O'Neil, 4 Oct. 1963 14 p refs
(Contract AF 33(616)-8423)
(TO-B 63-89; AD-429084)

Improvement of diagnostic photographic techniques for studying the acceleration and impact of hypervelocity particles is described. Progress is reported on use of streak-framing photography and a double-pulsed Kerr cell camera to take pictures of particles in flight. Author

**N64-14838** Gulton Industries, Inc., Albuquerque, N. Mex.
**INSTRUCTION MANUAL FOR SLED-BORNE TIMER**
[1963] 81 p
(Contract AF 29(600)-4171)
(AD-429069) OTS: $8.60

Instructions are given for the operation of a portable time-code generator that approaches laboratory stability in a rugged unit designed for sled-borne operation. Specifications, the theory of operation, and operating procedure are given along with definitions and logical symbols, schematics, and block diagrams. C.L.W.

**N64-14840*** Chicago U., Ill. Labs. for Applied Sciences
**OAO IMAGE CONVERTER RESEARCH Final Report**
Jay Burns 1963 38 p refs
(NASA Grant NsG-276-62)
(NASA CR-55425; LAS-TR-226-3) OTS: $3.60 ph, $1.34 mf

Performance requirements are defined for image converters that are used in conjunction with advanced generations of orbiting astronomical telescopes. These requirements include use of the image converter in various classes of observations that can be performed to advantage from an orbiting observatory. In light of these performance requirements, an attempt is made to see which of the techniques known at present appear to have promise of meeting the requirements now or after further development. C.L.W.

**N64-14846*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**SPACE ASTRONOMY AND THE SLOW-SCAN VIDICON**
Leonard R. Malling Repr. from J. Soc. Motion Picture Television Engrs., v. 72, Nov. 1963 p 872–875 refs
(NASA Contract NAS7-100)
(NASA CR-53053; JPL-TR-32-531)

Space astronomy is defined. In particular, the requirements for visual exploration of the Moon and Mars are outlined. The slow-scan vidicon is shown to be particularly useful as an astrophotographic instrument for space astronomy. The special instrumentation requirements for a slow-scan vidicon system are described for a Mars mission. Some of the techniques are illustrated with photos taken with a slow-scan vidicon system using as an optical objective the Mt. Wilson 60-in. telescope. Author

**N64-14858*** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
**A VACUUM ULTRAVIOLET PHOTOIONIZATION DETECTOR**
A. K. Stober, R. Scolnik, and J. P. Hennes Repr. from Appl. Optics, v. 2, Jul. 1963 p 735–739 refs (See N63-13220 07-15)
(NASA RP-32)

A small ceramic ion chamber has been developed for a rocket astronomy program in the vacuum ultraviolet. The chamber consists of a small metal-plated ceramic shell incorporating a window of LiF, $CaF_2$, or $BaF_2$ and containing a filling gas of nitric oxide, acetone, carbon disulfide, or others. Typical quantum yields range from 8% to 10% for acetone with $CaF_2$ window to 50% to 60% for carbon disulfide with LiF window. Details of the chamber construction are given, and some recent applications of the detector are described. Author

**N64-14884** Hanford Atomic Products Operation, Richland, Wash.
**TESTING REACTOR INSTRUMENTATION WITH EXPONENTIAL SIGNALS**
B. E. Dozer Oct. 1963 18 p refs
(Contract AT(45-1)-1350)
(HW-79127) OTS: $0.50

Some considerations in determining the response of reactor instrumentation to exponentially increasing signals are indicated. Several methods of testing these instruments and factors leading to poor response are given. A rising exponential generator was developed for use in some of these tests. Certain precautions necessary in its use are pointed out. Author

**N64-14901*** National Bureau of Standards, Washington, D.C.
**AN EXPERIMENTAL TECHNIQUE FOR THE DETERMINATION OF THE FIDELITY OF THE DYNAMIC RESPONSES OF PRESSURE TRANSDUCERS**
P. S. Lederer and R. O. Smith May 1963 48 p refs
(Sponsored by NASA, Navy, Army, and AF)
(NASA CR-55320; NBS-7862) OTS: $4.60 ph, $1.64 mf

This experimental technique for the determination of the fidelity of the dynamic responses of pressure transducers consists essentially of subjecting the transducer to a pressure step function by means of a shock tube, and simultaneously feeding the resultant transducer output to an oscilloscope (for a photographic record) and to a special magnetic transient recorder. This recorder records and preserves the transducer's transient output, which is played back repetitively at any convenient time into an automatically scanning, electronic spectrum analyzer. A photograph of the screen of the analyzer produces a picture showing the frequency components present in the transient and, very roughly, their relative amplitudes. This technique concerns only linear transducers or those whose actual dynamic behavior approaches that of the ideal linear system closely enough to justify the assumption of linearity. I.v.L.

**N64-14946** Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
**A SENSITIVE RADIATION MONITOR FOR A LARGE LABORATORY AREA**
LeConte Cathey and Richard A. Moyer Nov. 1963 13 p refs
(Contract AT(07-2)-1)
(DP-856) OTS: $0.50

An instrument has been built to survey releases of radioactivity within the 22-acre enclosure of the Savannah River Laboratory. The device consists of a 2-in.-diam. X 2-in. sodium iodide scintillation crystal with associated detector counting and recording circuits, which provide a permanent record of radioactivity movements within the Laboratory area. The monitor detects signals of 6.9 μr/hr from a 0.48-curie cobalt-60 source located 265 ft away. Author

# 16 LIFE SCIENCES

Includes biology, exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

**N64-14180*** RAND Corp., Santa Monica, Calif.
**MAN'S THERMAL BALANCE IN SPACE ENVIRONMENTS**
Herman P. Roth Oct. 1963 16 p refs Presented at the SAE Natl. Aeron. and Space Eng. Meeting, Los Angeles, 23–27 Sep. 1963
(NASA Contract NASr-21(08))
(NASA CR-55279; P-2810) OTS: $1.60 ph, $0.80 mf

Flight to the moon and man's personal exploration of its surface will impose thermal-control problems of both design and reliability of performance considerably beyond those required in an orbital-flight vehicle. Additional knowledge is vitally needed in a number of fields bearing directly on the problem of designing space vehicles and space suits. Questions raised concern the effect of true space environment on the materials which must protect man, the environmental control in the capsule, special problems of air circulation in the space suit and of equalizing the thermal condition between the shaded and nonshaded sides of the suit when man goes outside the space vehicle, the variability of heat production according to activity, and the problems caused by water. Achieving essentially 100% reliability is a matter of early design, thorough and complete testing with avoidance of change for a considerable period prior to critical use, and attention to the human factor. R.L.K.

**N64-14251** Joint Publications Research Service, Washington, D.C.
**CHANGES IN EPITHELIUM UNDER THE INFLUENCE OF RADIATION**
K. M. Svetikova et al 31 Dec. 1963 29 p refs Transl. into ENGLISH of 2 articles from Arkh. Anat., Gistol. i Embriol. (Moscow), v. 45, no. 10, Oct. 1963 p 51–66
(JPRS-22556; OTS-64-21184) OTS: $0.75

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2. CHANGES IN THE TRANSITIONAL EPITHELIUM AFTER THE ACTION OF IONIZING RADIATION A. V. Zhuravlev p 14–26 refs (See N64-14253 06-16)

**N64-14252** Joint Publications Research Service, Washington, D.C.
**REPARATIVE REGENERATION OF CUTANEOUS AND INTESTINAL EPITHELIA AT THE ANAL JUNCTION IN ACUTE RADIATION SICKNESS**
K. M. Svetikova *In its* Changes in Epithelium Under the Influence of Radiation 31 Dec. 1963 p 1–13 refs (See N64-14251 06-16)

In nonirradiated and in some irradiated animals, a wall of leukocytes was formed very quickly after thermal injury to the epithelia at the site of the anal junction, creating a barrier which prevented the penetration of the infection into the wound. In the majority of irradiated rats, the formation of the leukocyte wall was delayed. During this time, the infection, encountering no resistance, managed to develop both on the wound surface and in its depths. Under the influence of microbe toxins, tissue necrosis occurred at the base and edges of the wound. In both irradiated and nonirradiated animals, local differentiation of immature granulation tissue occurred differently, depending on the type of epithelium covering it. R.T.K.

**N64-14253** Joint Publications Research Service, Washington, D.C.
**CHANGES IN THE TRANSITIONAL EPITHELIUM AFTER THE ACTION OF IONIZING RADIATION**
A. V. Zhuravlev *In its* Changes in Epithelium Under the Influence of Radiation 31 Dec. 1963 p 14–26 refs (See N64-14251 06-16)

X-radiation in doses from 2400 r causes well-expressed radiation changes in the cutaneous epithelium. Taking into consideration the genetic similarity between cutaneous and transitional epithelia, a dose of 3000 r was selected for the irradiation of white rats in order to compare the times of the radiation changes in the transitional epithelium with changes in epithelium of the abdominal skin exposed to irradiation at the same time. Data on the following are included in tabular form: (1) the change in the mitotic coefficient and number of binucleated cells in the transitional epithelium of the bladder and the mitotic coefficient of the epidermis of the skin of the

abdomen after a single irradiation dose of 3000 r; and (2) the change in the nuclear volume of transitional epithelial cells after local X-rays irradiation of 3000 r. R.T.K.

**N64-14304** Spacelabs, Inc., Van Nuys, Calif.
**METHOD OF PRESERVING FROZEN FOOD DURING AN AEROSPACE MISSION Final Report, Feb.-Nov. 1962**
Robert R. Reddy and Eugene B. Zwick Wright-Patterson AFB, Ohio, Biomedical Lab., Apr. 1963 36 p refs
(Contract AF 33(657)-8019)
(AMRL-TDR-63-31; SR-62-1047; AD-407423) OTS: $1.00

Analyses of three nonelectrical methods for maintaining frozen foods between −10° and +5° F during aerospace missions of 1 to 28 days are presented. The methods considered are: (1) a heat sink, (2) active refrigeration, and (3) radiation cooling. All methods appear feasible. The heat sink method appears to be the simplest and most reliable. A design study of a heat sink system for a 3-man, 14-day mission is included. Author

**N64-14324** Texas U., Galveston Medical Branch
**SIMPLIFIED STANDARDIZED TREATMENT OF BURNS UNDER EMERGENCY CONDITIONS WITH PARTICULAR REFERENCE TO ALLIED HEALTH PERSONNEL**
T. G. Blocker, Jr. and Virginia Blocker [1963] 65 p
(Contract OCD-OS-62-129)
(AD-426228)

Guidelines are presented for simplified austere medical care for victims of thermal injuries during a national disaster. The report is designed to assist in emergency planning and for training of members of the allied health professions. The program covers the identification of allied health personnel and suggests the carrying of proper identification cards. Diagnosis and triage was also covered and included treatment for different types of burns. An outline was then given for austerity therapy and included a general plan of management, local treatment, and fluid therapy. C.L.W.

**N64-14333** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**NEW METHODS IN MEDICINE**
V. D. Timakov (Akad. Med. Nauk SSSR) 10 Oct. 1963 68 p Transl. into ENGLISH from "Novyye Puti Meditsiny", Moscow, Izd"Znaniye", 1963 p 1-48
(FTD-TT-63-732/1+4; AD-423604)

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6. THE LAND OF LONGEVITY V. D. Timakov p 54-63

**N64-14334** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**CYBERNETICS APPROACHES THE FUTURE**
V. D. Timakov *In its* New Methods in Med. 10 Oct. 1963 p 39-48 (See N64-14333 06-16)

The future of cybernetics in the field of medicine is reviewed. Cybernetic computers will be used for the diagnosis of diseases and the quick and accurate processing of a large volume of often changing information. The value of the cybernetic diagnostic computer consists of the fact that it supplements the memory of the doctor by its electronic "memory", which never forgets anything. Cybernetic computers will solve such complicated problems as rapid, accurate interpretations of special studies of the brain (electroencephalograph) and of the heart (electrocardiograph). They will be able to "read" and "interpret" the data of radiographic investigations including such complicated ones as angiography and tomography, and also the results of laboratory analysis of blood, cerebrospinal fluid, bone marrow, gastric juice, etc. The computers will be able to quickly receive the information from instruments about the changing condition of the patient being operated on and will simultaneously note and evaluate the first signs of alarm. I.v.L.

**N64-14335** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**POLYMERS IN MEDICINE**
V. D. Timakov *In its* New Methods in Med. 10 Oct. 1963 p 49-53 (See N64-14333 06-16)

The uses of plastics in medicine include the following: (1) to make an artificial prosthesis of the head of the femur; (2) to eliminate the so-called relaxation of the diaphragm by using a plastic flap made of polyvinyl alcohol; (3) to sew up wounds of the chest and abdominal cavity; (4) to replace a section of damaged or worn blood vessels; (5) to fill the cavities of hollow-bone transplants, thus aiding complicated osteoplasty; and (6) to synthesize a blood substitute, into which drugs can be incorporated, that is retained by the organism for a rather long period of time. I.v.L.

**N64-14351** Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
**THE NON-PROTEIN AMINO ACIDS AND RELATED COMPOUNDS OF RAT LIVER MITOCHONDRIA**
Herman W. Shmukler 18 Oct. 1963 23 p refs
(Rept. 21; NADC-MA-6318; AD-428381) OTS: $2.60

The nonprotein amino acids and related compounds of rat liver mitochondria have been analyzed by automatic ion exchange chromatography. Twenty-seven ninhydrin positive peaks were obtained. The identity of these chromatographic peaks is discussed. Mitochondria frozen at −20° for 24 hours showed no change in the free amino acid composition; however, a fourfold increase in the free peptide content was observed. Storage of fresh mitochondria at 0° for 6 days resulted in a sevenfold increase in the free amino acid content with a fifteenfold increase in the free peptide content. Author

**N64-14372** Dynamic Science Corp., South Pasadena, Calif.
**A GENERAL REVIEW OF CHEMICAL STERILIZATION IN SPACE RESEARCH**
John B. Opfell 1963 18 p refs Presented at the COSPAR 4th Intern. Space Sci. Symp., Warsaw, 3-12 Jun. 1963

In space research in the United States, recent work on chemical sterilization has laid heavy emphasis on the identification and exploration of principles of engineering sciences which control sterilization effectiveness. These principles are reviewed, and their significance in chemical sterilization is discussed in terms of the engineering factors involved. Among these factors are: consequence of sterilant polymerization or reaction with the object to be sterilized; criteria for chemical

sterilization process effectiveness; depletion of the concentration of the sterilant by evaporation or chemical reaction, including polymerization; obstacles to the diffusion or convection of the sterilizing chemical to the immediate vicinity of the microorganisms to be destroyed; protection of the microorganisms from direct contact with the sterilant; phase behavior of the sterilant in the environment of the sterilization process; presence of water or water vapor; the nature, sources, and numbers of microorganisms which survive standard chemical sterilization processes; and the length of exposure required to sterilize at each temperature. Author

**N64-14375** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**CERTAIN PROBLEMS OF SPACE PSYCHOLOGY**
F. D. Gorbov 7 Oct. 1963 23 p Transl. into ENGLISH from Vopr. Psikhologii (Moscow), no. 6, 1962 p 3-13
(FTD-MT-63-68/1+3+4; AD-428547) OTS: $2.60

On the basis of results obtained in special loading tests applied in the training of flying personnel, the "principle of reproduction" is advanced as one of fundamental importance for space psychology. Some new methods of psychological research founded on this principle are proposed, such as diagnoses of suggestivity and noise immunity. The use of a homeostatic method in the study of group psychology permits differentiating several patterns of individual strategy in the integrative performance of operators. Author

**N64-14395** Brookhaven National Lab., Upton, N.Y.
**1962 ENVIRONMENTAL RADIATION LEVELS AT BROOKHAVEN NATIONAL LABORATORY**
A. P. Hull May 1963 16 p refs
(BNL-807(T-310)) OTS: $0.50

Measurements made of "natural background" radiation levels (including fallout contributions) during 1962, and perturbations in this natural background attributable to laboratory operations (radiation from the $Ar^{41}$ content of the Brookhaven Graphite Research Reactor, BGRR, cooling-air effluent, from an ecology field gamma source, and from the discharge of low-level liquid wastes) are discussed. The natural background increased from an average of 2.84 mr/wk during January 1962 to 3.96 mr/wk during December 1962. The highest yearly average on-site radiation level from $Ar^{41}$ was 3.1 mr/wk (for 168 hr). No activity attributable to laboratory operations was detected in air-particulate monitoring samples. The activity in rain and settled-dust collection averaged 325.2 $\mu\mu C/m^2$/month. The average concentration in measurable precipitation was 1,340 $\mu\mu C$/liter. Except for periods when recently produced fallout isotopes were prevalent, the results of a monthly milk-sampling program were generally below 10 $\mu\mu C$/liter for $I^{131}$. P.V.E.

**N64-14409** Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
**THE MITIGATION OF PHYSICAL FATIGUE WITH "SPARTASE"**
Francis J. Nagle, Bruno Balke, Richard V. Ganslen, and Audie W. Davis, Jr. Jul. 1963 12 p refs
(CARI-63-12)

Pharmacological and clinical observations have indicated that Spartase—the aspartic acid salts of potassium and magnesium—takes part in the intermediary metabolism and moderates physical fatigue. In this study, attempts were made to evaluate effects of the drug on work capacity before and after episodes of physically fatiguing exercises. Work capacity was determined by a standardized treadmill test. The test was repeated after the subject had been running cross-country for a period of 60 min, and again after another such period of 40 min. In this way, effects of fatigue upon functional adaptability to stress became apparent. Spartase was taken orally in a prescribed dose for 2 weeks, whereupon the same testing procedure was reapplied. The results indicated that Spartase improved the endurance performance of untrained individuals engaging in extremely fatiguing physical work. It appeared to have no effect on highly trained individuals. Author

**N64-14410** Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
**A CENTRAL FACTOR IN PURE TONE AUDITORY FATIGUE**
Joel S. Wernick and Jerry V. Tobias Sep. 1963 8 p refs
(CARI-63-19)

The present study was designed to evaluate the possibility that a listener's level of mental activity constitutes an adequate central factor. Subjects were presented with a 4000 cps, 40 db SL or 90 db SL tone for 3 minutes under conditions of a mental task or of reverie. Pre- and post-fatigue thresholds were measured with a switched (0.2 sec on, 0.2 sec off) tone. For low level (40 db) fatigue the frequency of the test tone was 4,000 cps and for high level (90 db) fatigue, 5,656 cps. Subjects consistently showed greater temporary threshold shift and longer recovery time when the fatiguing tone was presented in the mental task condition. Results thus indicate a central factor in pure tone auditory fatigue. It is suggested that the degree of effect of a fatiguing tone is a function of the listener's degree of mental activity during stimulation. Author

**N64-14411** Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
**APPLICATION OF A "RELATIVE" PROCEDURE TO A PROBLEM IN BINAURAL BEAT PERCEPTION**
Jerry V. Tobias Aug. 1963 10 p refs
(CARI-63-17)

The existence of binaural beats has long been considered an indication of binaural interaction for timing and periodicity information. In the past, bilaterally matched sound pressure or sensation levels have been used in the investigation of these beats, and the measuring technique was one which may be termed "absolute." However, the present study, in investigating with a "relative" technique the limits of dichotic intensity that permit binaural beats, shows that listeners respond to the presence of beats whenever the tones to both ears are above threshold. It is suggested that this new result fits more neatly into current theoretical formulations. The frequencies investigated ranged from 100 to 2000 cps. As other authors have previously reported, the best performance occurred in the 400 to 600 cps range. The present findings strengthen the case for an auditory nervous system with timing channels independent of other transmission lines. Author

**N64-14428** California U., Berkeley. Lawrence Radiation Lab.
**ANALYSIS OF X-RAY-INDUCED MITOTIC DELAY IN SEA URCHIN EGGS**
Bhashini Rao (Ph.D. Thesis) 20 Aug. 1963 69 p refs
(Contract W-7405-eng-48)
(UCRL-10979) OTS: $1.50

Detailed cytological analysis showed that sublethal doses of X-rays affected the process of chromosome condensation in the eggs. The delay in chromosome condensation corresponded directly to the delay in cell division. Rate and time course of DNA synthesis in these cells was studied over two division cycles by following the incorporation of tritium-labeled

thymidine. X-ray doses that caused reversible mitotic delay had no effect on the time or rate of DNA synthesis in these cells; delay of DNA synthesis in the second division was a result of interference with mitosis. Variation of mitotic delay with dose and time of irradiation was studied. A critical point existed in prophase. If cells were irradiated before this point, there was a delay in the first cleavage. Cells irradiated after this point did not show any delay in the first cleavage, but the second cleavage was delayed. Shortly before the onset of the visible prophase, there was a stage in which the delay produced by a given dose was maximum. Author

**N64-14442** Oak Ridge National Lab., Tenn. Health Physics Div.

**CHROMOSOMAL ABERRATIONS IN A NATURAL POPULATION OF CHIRONOMUS TENTANS EXPOSED TO CHRONIC LOW-LEVEL ENVIRONMENTAL RADIATION**

B. G. Blaylock, S. I. Auerbach, and D. J. Nelson 29 Jan. 1964 86 p refs

(Contract W-7405-eng-26)

(ORNL-3531)

The salivary gland chromosomes of *Chironomus tentans* larvae collected from White Oak Creek, an area contaminated by radioactive waste, and from six uncontaminated areas were examined for chromosomal aberrations. Chromosomal maps were constructed to make a general comparison of the banding pattern of the chromosomes in the East Tennessee area with those of Canada and Europe. These maps were used as a reference in scoring aberrations. Fifteen different chromosomal aberrations were found in 365 larvae taken from the irradiated population as compared with five different aberrations observed in 356 larvae from six control populations, but the mean number of aberrations per larvae did not differ in any of the populations. Also, five different inversions were found in both irradiated and control populations; three inversions—1Ra, 2Lab, and 3Ra—were found at a relatively high frequency and were used in testing the seasonal and geographic distribution. I.v.L.

**N64-14470** North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

**SPACE VEHICLE THERMAL AND ATMOSPHERIC CONTROL RESEARCH PROGRAM**

R. E. Sexton [1962] 37 p refs

(Contract AF 33(616)-8953)

(AD-428573) OTS: $3.60

General problems associated with selection of environmental control systems for space vehicles and analytical techniques that have been developed which will be of general interest to persons concerned with this type of work are discussed. The following areas of thermal and atmospheric control problems are discussed: (1) thermal control systems—external heat flux, configuration factors, transient thermal solutions, transient thermal tests, space radiators; and (2) atmospheric control systems—nonregenerative and regenerative systems. P.V.E.

**N64-14523** Joint Publications Research Service, Washington, D.C.

**SOVIET RESEARCH IN PHYSIOLOGY, BIONICS, AND BIOPHYSICS**

31 Jan. 1964 12 p refs Transl. into ENGLISH of 3 articles from Kommunist (Yerevan), 1963

(JPRS-23022; OTS-64-21453) OTS: $0.50

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1. PROSPECTS FOR BIOPHYSICS G. Demirchoglyan p 1-3 ref

2. WHAT IS BIONICS? I. Gambaryan p 4-6

3. THE FUTURE OF PHYSIOLOGY V. Chernigovskiy p 7-9 ref

**N64-14526** Joint Publications Research Service, Washington, D.C.

**STUDIES ON TOXIC CHEMICALS AND LABOR HYGIENE IN THE CHEMICAL INDUSTRY**

3 Feb. 1964 26 p refs Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), no. 11, 1963 p 3-8, 17-20, 41-43, and 60-64

(JPRS-23045; OTS-64-21468) OTS: $0.75

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2. SOME PROBLEMS OF CURRENT IMPORTANCE IN PRESENT-DAY INDUSTRIAL TOXICOLOGY V. A. Pokrovskiy (Med. Inst., Voronezh) p 8-11 refs

3. HYGIENIC CHARACTERIZATION OF LABOR CONDITIONS IN THE CHLOROPHOS INDUSTRY V. N. Trefilov and M. D. Skanavi (Inst. of Labor Hyg. and Occupational Diseases) p 12-16 refs

4. CHANGES IN THE CEREBRAL BIO-ELECTRICAL ACTIVITY IN WORKERS FROM THE EFFECT OF MERCURY K. Kiryakov (Transport Med. Lab., Sofia) p 17-23 refs

**N64-14529** Joint Publications Research Service, Washington, D.C.

**TEMPERATURE DEPENDENCE OF LUMINESCENT BACTERIOVIRIDIN AND ITS STATE IN PHOTOSYNTHETIC BACTERIA**

A. A. Krasnovskiy et al 4 Feb. 1964 9 p refs Transl. into ENGLISH of an article from Dokl. Akad. Nauk SSSR (Moscow), v. 152, no. 5, 1963 p 1231-1234

(JPRS-23054; OTS-64-21471) OTS: $0.50

The temperature dependence of bacterioviridin luminescence intensity at various maxima in pyridine solution, in solid film, and in green sulfur bacteria (*Chloropseudomonas ethylicum*, strain T.) was investigated. Results indicate that the different intensity of fluorescence is related to the density and packing type of the pigment and to the content of solvent molecules present. The more densely packed forms attain maximum values of luminescence intensity in freezing earlier and more rapidly compared to the less densely packed pigment forms. Upon reducing the temperature to −196° C, the fluorescence maxima of aggregate bacterioviridin forms always shift strongly toward the long-wave side, since the position of the maximum of the "monomeric" form is practically independent of temperature. I.v.L.

**N64-14530** Joint Publications Research Service, Washington, D.C.

**SOME PHILOSOPHICAL PROBLEMS OF THE INTERRELATIONSHIP OF PHYSIOLOGY AND CYBERNETICS**

O. F. Makarchenko and M. L. Gorbach 4 Feb. 1964 14 p Transl. into ENGLISH of an article from Fiziol. Zh. Akad. Nauk Ukr. RSR (Kiev), v. 9, no. 6, 1963 p 707-715

(JPRS-23060; OTS-64-21477) OTS: $0.50

Problems are discussed concerning the precise objective definition of the nature of life and thought in connection with modeling them on cybernetic machines. I.v.L.

**N64-14536** Joint Publications Research Service, Washington, D.C.
**MIRACLE OF OUR TIME, CYBERNETICS AND PROBLEMS OF DEVELOPMENT**
B. V. Akhlibininskiy and N. I. Khralenko 7 Feb. 1964 111 p Transl. into ENGLISH of the book "Chudo nashego vremeni, kibernetica i problemi razvitiya", Leningrad, Lenizdat Publishing House, 1963 p 1–140
(JPRS-23132; OTS-64-21517) OTS: $2.50

This report contains discussions on the following: (1) the basic concepts of cybernetics; (2) development and information; (3) cybernetics and the essence of life; (4) time in cybernetics; (5) the method of modeling processes; and (6) progress and entropy. I.v.L.

**N64-14542** Joint Publications Research Service, Washington, D.C.
**THE NATURE OF THE DERMO-OPTICAL SENSE IN MAN**
A. S. Novomeyskiy 4 Feb. 1964 26 p refs Transl. into ENGLISH of an article from Vopr. Psikhologii (Moscow), v. 9, no. 5, Sep.–Oct. 1963 p 99–117
(JPRS-23068; OTS-64-21481) OTS: $0.75

Various experiments on the nature of the dermo-optical sense in man are described. Results indicate that, under the effect of illumination on the surface of a particular color, differences in electrical potentials are created that interact differently with the electricized skin of the hand. There is a connection between the electricized skin and the field of the colored surface of the paper that, in turn, causes variations in degree of slickness and retention when the fingers are moved along the colored surface. When the lighting is changed, the nature of this connection changes; it becomes either stronger or weaker. There is a corresponding change in the nature of arising tactile sensations of smoothness or roughness. In total darkness this connection disappears, and tactile perception of color becomes impossible. Thus it appears that dermo-optical sensations send mediated signals about the particular properties of the colored surface—the electrical potentials of every color. The positive results obtained with the use of the insulator setup with the blind and visually handicapped, under conditions of illumination, confirmed the theory on the electrical nature of dermo-optical sensations. I.v.L.

**N64-14544** Federal Aviation Agency, Oklahoma City, Oklahoma Civil Aeromedical Research Inst.
**PRIMARY, SECONDARY, AND CALORIC NYSTAGMUS OF THE CAT FOLLOWING HABITUATION TO ROTATION**
William E. Collins Jul. 1963 21 p refs
(CARI-63-13)

Ten cats were exposed to a series of above-threshold accelerations and subthreshold decelerations. Unilateral caloric irrigations, provoking nystagmus in the same direction as the above-threshold rotational stimuli preceded and followed the set of accelerations. A marked adaptation of nystagmus, characterized by specific changes in early trials, resulted from repeated rotation. Although neither duration nor total slow-phase eye displacement to caloric stimulation was affected, the intervening rotational experience produced some reduction in the frequency of the nystagmic beats. The data indicate that clinical (caloric) responses to vestibular stimulation may not give an accurate indication of a subject's state of adaption to "practiced" levels of angular acceleration. Such findings provide cautions in the establishment of appropriate testing techniques for the analysis of vestibular function in aircraft or space-vehicle crew members. Author

**N64-14568** Atomic Energy Commission, Washington, D.C.
**MARINE SCIENCES RELATED TO AEROSPACE USES OF NUCLEAR POWER**
Arnold B. Joseph *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 195–207 refs (See N64-14551 06-01) OTS: $4.50

Studies to define the risks of radioactivity in the marine environment are discussed. The following are considered: source-term studies, marine studies, structure of the ocean environment, physical studies, biological studies, and concentration guides for sea water. R.T.K.

**N64-14580*** Council for International Organizations of Medical Sciences (CIOMS), Paris (France)
**SELECTIVE VULNERABILITY OF THE BRAIN IN HYPOXAEMIA Symposium**
J. P. Schade (Neth. Central Inst. for Brain Res.) and W. H. Mc Menemey (Maida Vale Hosp. for Nervous Diseases), eds. Oxford, Blackwell, 1963 407 p refs Symp. held in Baden, Switz.
(NASA Grant NsG-180-61)
Available from Blackwell: 70s

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**N64-14581*** Cologne U. (W. Germany)

**CRITICAL BLOOD PRESSURE IN THE CEREBRAL CIRCULATION**

M. Schneider *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 7–20 refs (See N64-14580 06-16) Available from Blackwell: 70s

The critical blood pressure is the range of mean arterial pressure where blood flow in the brain reaches a critical level inasmuch as the average $O_2$ uptake begins to decrease and severe mental disturbances occur. The mean venous $O_2$ pressure then lies around 19 mm Hg, from which can be calculated that the $O_2$ pressure in the parts of the tissue poorest supplied falls to about 4 mm Hg, a range at which the respiratory enzymes are already undersaturated. It can be calculated that in acute oligemia, severe mental disturbances already occur when only a small fraction of the cells is rendered anoxic. This stage is critical because a depression of respiration begins, and the hypoxidosis is continuously increased. When the blood pressure is lowered slowly below the normal level, blood flow at first does not change because of the autoregulation of cerebral circulation. The development of the autoregulation in the brain is a slow process. Therefore, when the blood pressure falls rapidly below the normal level, the brain blood flow also falls, and a critical level is reached with a mean arterial pressure of 60 to 70 mm Hg. I.v.L.

**N64-14582*** Johns Hopkins U., Baltimore, Md.

**REGIONAL CIRCULATION OF THE BRAIN UNDER PHYSIOLOGICAL CONDITIONS. POSSIBLE RELATIONSHIP TO SELECTIVE VULNERABILITY**

Seymour S. Kety *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 21–26 refs (See N64-14580 06-16) Available from Blackwell: 70s

A new method for the measurement of local circulation in physiological states is discussed. Diffusible substances introduced into the arterial circulation pass freely into the various tissues. In the case of certain lipid soluble substances, the entire capillary wall is available for diffusion and in the most active tissues, of which the brain is one, the intercapillary distances are sufficiently small for equilibrium, with arterial concentrations to be achieved almost immediately. Under such circumstances, it can be shown that the tissue concentration ($C_i$) at the end of a definite time (T) can be described by the expression: $C_i(T) = \lambda_i k_i \exp(-k_i T) \int_0^T C_a \exp(k_i t)dt$ where $C_a$ refers to the arterial concentration, $\lambda_i$ refers to the tissue:blood partition of the substance, and $k_i = F_i/\lambda_i V_i$, or capillary blood flow per unit quantity of tissue, divided by the partition coefficient. Diffusible substances labeled with $I^{131}$ have been used to permit the continuous monitoring of their concentration in arterial blood by means of a scintillation counter, and their concentrations have been determined in various tissue regions at the end of a measured time period by autoradiography. I.v.L.

**N64-14583*** Neue U., Kiel (W. Germany)

**IMPLICATIONS TO PHYSIOLOGY AND PATHOLOGY OF OXYGEN DIFFUSION AT THE CAPILLARY LEVEL**

G. Thews *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 27–35 refs (See N64-14580 06-16) Available from Blackwell: 70s

The determination of the values of oxygen tension in the grey matter of the brain was investigated. The model used was based on the following: The average oxygen tension within the capillary amounts to 95 mm Hg at the arterial end, and to 34 mm Hg at the venous end. The oxygen diffuses radially

from the capillary into the surrounding tissue and supplies a cylindrical region. The radius of the capillary is approximately 2.5 to 3μ; the radius of the surrounding tissue cylinder is 30μ. (There are two adjacent tissue cylinders, each containing a capillary.) The oxygen consumption is assumed to be $5 \cdot 10^{-2}$ [ml $O_2$/ml tissue/min]. Results are as follows: The oxygen tension in the region of the lowest supply (lethal corner) was approximately 17 mm Hg; under conditions of hypoxaemia it was 11 mm Hg at the reaction threshold, 4 mm Hg at the critical threshold, and 0 mm Hg at the lethal threshold. Thus it can be concluded that a critical analysis of the processes of diffusion shows that the values of oxygen tension in the grey matter are lower than was previously assumed. Under conditions of hypoxia, the effects of the reduced oxygen supply set in whenever the oxygen tension as the lethal corner was not sufficient for a complete saturation of the cytochrome oxidase. I.v.L.

**N64-14584*** Oxford U. (Gt. Brit.) Nuffield Inst. for Medical Research

**COMMENTS ABOUT BRAIN CIRCULATION, OXYGEN SUPPLY, AND ANOXIC SURVIVAL**

G. S. Dawes *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 37-40 refs (See N64-14580 06-16) Available from Blackwell: 70s

Survival in the extreme case of acute anoxia depends upon: (1) the minimal energy requirements and (2) the substrate availability for energy supply by anaerobic glycolysis that are (a) local carbohydrate reserves (these are certainly low but they may be variable in different parts of the brain) and (b) the diffusion of glucose from the bood. Also to be considered are (a) the susceptibility of local enzymes to the fall in tissue pH produced by acid metabolites and (b) the buffering power of the local tissues and the ability of the circulation to remove acid metabolites. Thus it appears that the maintenance of an adequate cerebral circulation prolongs survival in anoxia. Hence, the density of local blood supply may have a particular significance not only in supplying $O_2$ but, during hypoxia, in providing carbohydrate and removing hydrogen ions. It may well be that the limiting factors to which attention should be directed in acute total hypoxia are not so much the diffusibility of $O_2$, but the diffusibility of glucose and hydrogen ions during hypoxaemia. I.v.L.

**N64-14585*** Royal Aircraft Establishment, Farnborough (Gt. Brit.)

**SOME EFFECTS OF BRIEF PROFOUND ANOXIA UPON THE CENTRAL NERVOUS SYSTEM**

J. Ernsting *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 41-45 refs (See N64-14580 06-16) Available from Blackwell: 70s

The effects of brief profound anoxia upon the nervous system were investigated by noting the changes reported by the subjects, by recording their performance on a sequential motor task, and by EEG. The subjects, after a period of 5 minutes at 8,000 ft, were decompressed to 38,000 ft. in 1.5 sec. They breathed air at 8,000 ft; oxygen was delivered after compression. Results are as follows: (1) All subjects reported some mental confusion, and some subjects reported either a general dimming of vision or loss of peripheral vision. (2) Significant impairment of motor task performance was reported. (3) A change in the EEG was noted, commencing at 15.4 sec. (mean value). In five out of six subjects, this change consisted of the appearance of 8 to 13 c/s activity similar in amplitude to the alpha rhythm produced by eye closure. This change occurred in all four channels and persisted until 24.7 sec (mean value) after decompression. In the sixth subject, high-voltage 3 to 4 c/s activity appeared, in addition to the 8 to 13 c/s activity. I.v.L.

**N64-14586*** Toronto U. (Canada)

**MEASUREMENT OF POST-MORTEM LACTIC ACID CONCENTRATIONS IN ASSESSING AN ANTE-MORTEM HYPOXIA**

W. R. Franks *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 47-54 refs (See N64-14580 06-16) Available from Blackwell: 70s

During ante mortem hypoxia there is an increased accumulation of lactic acid precursors plus a varying increase in this end product of glycolysis itself. When the hypoxia leads to fatal termination, suitable post mortem examination should record these changes. After such a death, surviving glycolytic enzymes break down the persisting lactate precursors, mobilized during life in increasing amounts, to lactic acid that is added to any lactate already accumulated as a result of the ante mortem asphyxia. It is thus necessary to measure only (total) lactate concentration to indicate the extent of this biphasic response to the hypoxia. By using a modification of the Barker and Summerson method (1941) for lactate measurement, which modification consists of preserving the pathological specimens by freezing during transportation to the laboratory, an adequate determination can be carried out on approximately 100 milligrams of fresh tissue. It was found that, in the intact skull, the brain is sufficiently protected from the atmosphere to allow useful samples to be recovered at autopsy many hours after death. I.v.L.

**N64-14587** Lund U. (Sweden)

**STUDIES OF THE REGIONAL METABOLISM AND CIRCULATION OF THE CEREBRAL CORTEX**

D. H. Ingvar *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 55-61 refs (See N64-14580 06-16) Available from Blackwell: 70s

Selective vulnerability to anoxaemia within the central nervous system apparently depends upon regional differences in the metabolism and circulation. It then follows that a greater vulnerability of one region, in comparison to another, would be related to regional differences in circulatory homeostatic mechanisms, i.e., all factors pertaining to the tissue and its vessels that tend to secure an adequate oxygen supply. In this report new methods are discussed by which the regional cerebral blood flow and metabolism can be quantitatively studied *in vivo* in circumscribed parts of the gray matter of the cerebral cortex. The regional cerebral blood flow is quantitatively measured based upon the measurement of the rate of clearance of an inert radioactive gas, $Kr^{85}$, which is brought to the cerebral tissue by intracarotid injection of small amounts of saline in which $Kr^{85}$ is dissolved. The regional cerebral metabolism is calculated from the above blood flow measurement plus a representative arterio-venous difference of oxygen (and of carbon dioxide). I.v.L.

**N64-14588*** Buffalo U., N.Y.

**CENTRAL NERVOUS SYSTEM VULNERABILITY IN HYPOXAEMIC STATES. ISOTOPE UPTAKE STUDIES**

L. Bakay and H. H. Bendixen *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 63-78 refs (See N64-14580 06-16) Available from Blackwell: 70s

The exchange of trypan blue, radioactive serum albumin, $Na^{24}$, and $P^{32}$ between blood and the central nervous system was studied in cats. Experimental conditions included hypoxia with hypercapnia, hypoxia without $CO_2$ accumulation, hypercapnia with normal oxygenation, and increased venous and CSF pressure with normal oxygenation and $CO_2$ elimination. Changes in arterial, venous, and CSF pressure were recorded and analyzed. The blood-brain barrier remained impermeable to trypan blue and serum albumin during the experiments. The combination of severe hypoxia and $CO_2$ accumulation increased

the cerebral uptake of sodium as well as phosphate; neither hypoxia nor hypercapnia alone produced a similar effect. The increase in $Na^{24}$ and $P^{32}$ concentration was caused by a true absorption by the nervous tissue rather than by a mere increase in cerebral blood content. Author

**N64-14589*** Göteborg U. (Sweden)
**COMMENTS ABOUT THE BLOOD-BRAIN BARRIER IN HYPOXIA AND HYPOCAPNIA**
T. Broman *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 79–88 (See N64-14580 06-16) Available from Blackwell: 70s

Experiments were conducted concerning the passage of certain test substances through the blood–brain barrier into the normal and into the chemically damaged brain, *in vivo* and *post mortem*. Three different test substances were chosen that under normal conditions cannot pass through the barrier, viz., trypan blue, prontosil, and radioactive chromium in a citrate buffer solution. Preliminary results showed that all three test substances behaved in the same way and that there were no significant differences if the experiments were made *in vivo* or during a *post mortem* perfusion. This means that the barrier effect is still at work after death, i.e., during a state of maximal hypoxia. Experiments on the possible effect of hypercapnia on the blood–brain barrier in rabbits demonstrated that the breakdown of the barrier was limited to the (late) hypercapnic state and that the barrier was normalized in a very short time after the cessation of the $CO_2$ inhalation. The breakdown effect in long-standing hypercapnia appears earliest and seems to be most pronounced in the brain stem and is associated with a tendency to small capillary bleedings. I.v.L.

**N64-14590*** Netherlands Central Inst. for Brain Research, Amsterdam
**FUNCTIONAL CORRELATES OF IONIC MOVEMENTS IN THE CEREBRAL CORTEX**
J. P. Schade *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 89–99 refs (See N64-14580 06-16) Available from Blackwell: 70s
(NIH Grant B-3048; Neth. Organ. for Pure Res. Grant ZWO-563-15)

The impedance of a tissue such as the cerebral cortex is mainly a function of the extraneuronal electrolytes, assuming that the membranes of the neurons have infinite resistance. Movement of ions from the extraneuronal to the intraneuronal compartment and vice versa can be detected by changes in the electrical impedance. After asphyxiation, a transport of sodium chloride, accompanied by water, into the apical dendrites of the cortical neurons takes place. A rapid impedance rise is observed accompanying this asphyxiation. During spreading depression similar, though smaller, impedance changes and ionic movements are seen. Spreading depression is accompanied by a wave of vasoconstriction and a drop in oxygen tension. During hypothermia minor movements of ions are observed. The transport of sodium chloride after circulatory arrest is significantly delayed. Author

**N64-14591*** Naval Submarine Base, New London, Conn.
**THE EFFECTS OF $CO_2$ AND ELECTROLYTE SHIFTS ON THE CENTRAL NERVOUS SYSTEM**
K. E. Schaefer *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 101–123 refs (See N64-14580 06-16) Available from Blackwell: 70s

Studies in human subjects who inhaled 3.3, 5.4, and 7.5 percent $CO_2$ over a period of 15 minutes demonstrated a dissociation of effects on the central nervous system and the autonomic nervous system. The sympathetic division of the autonomic system was stimulated as shown in an increase of oxygen consumption, pulse rate, and muscle potentials, while the central nervous system was depressed as indicated in the decrease in flicker fusion threshold and an increase in latent time of alpha blocking following light stimulus. A time–concentration relationship of $CO_2$ effects on brain excitability was established using metrazol-induced seizures in rats during prolonged exposure to 10 percent $CO_2$ and 30 percent $CO_2$. Acid–base balance and electrolyte shifts were studied in rats during exposure to various high concentrations of $CO_2$ and during withdrawal seizures. A relationship between convulsive activity, change in $pCO_2$ (blood), and decrease in ultrafiltrable calcium was observed. Author

**N64-14592*** Max-Planck-Institut für Hirnpathologie Munich (W. Germany)
**ELECTRON MICROSCOPICAL OBSERVATIONS ON THE EARLY CHANGES IN NEURONS CAUSED BY HYPOXIDOSIS AND ON THE ULTRASTRUCTURAL ASPECTS OF NEURONAL NECROSIS IN THE CEREBRAL CORTEX OF MAMMALS**
Hermann Hager *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 125–136 refs (See N64-14580 06-16) Available from Blackwell: 70s

Syrian hamsters were exposed to conditions of acute hypoxia by repeated nitrogen asphyxiation. Histotic hypoxidosis, due to suppression of the cytochrome oxidase system, was produced by intoxication with potassium cyanide. Electron microscopical observations on necrotic neurons were made in the cerebral cortex by means of experimental traumatic lesions. After repeated episodes of nitrogen asphyxiation, alterations in the neurons were fairly well defined. The nucleus and the nuclear membrane remained relatively intact. The cytoplasm showed distinct alteration. As a rule the Nissl substance near the nucleus was better preserved than at the periphery of the cytoplasm. The mitochondria became swollen, and their internal membranes lost their parallel structure, underwent fragmentation, and finally disappeared almost completely. The matrix was loosened and became invisible. At the same time or even before, changes occur in the fine structure of the Nissl substance. The membrane systems of the endoplasmic reticulum became swollen. The R N P granules became greatly rarefied or formed lumps. The result of total necrosis is a dissociation of the neuropile. The surface membrane appeared "soaked" and showed signs of disintegration. I.v.L.

**N64-14593***
**MORPHOLOGICAL ASPECTS OF WATER AND ION SHIFTS IN THE CNS**
E. de Robertis *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 137–149 refs (See N64-14580 06-16) Available from Blackwell: 70s

The morphological aspects of water and ion shifts in the central nervous system are reviewed. Experiments on the frog brain are being observed microscopically, in which shifts of water and the ionic fluxes are being simultaneously studied. Preliminary observations confirm that in this brain the water retention by ouabaine treatment is mainly in glial processes. The swelling induced by an isomolar replacement of NaCl by KCl also results in an increase in size of the glia. All indications suggest that astroglia are cells with a high $Na^+$ content and are cells in which water shifts and ion fluxes follow a pattern similar to that in the extracellular space of other tissues. I.v.L.

**N64-14594*** Philipps Universität, Marburg (W. Germany)
**CNS TISSUE AND CELLULAR PATHOLOGY IN HYPOXAEMIC STATES**
H. Jacob *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 153–163 refs (See N64-14580 06-16) Available from Blackwell: 70s

There are some differences in vulnerability to hypoxaemia among intracellular structures and between the cell body and its peripheral processes. Such intracellular vulnerability apparently exists in both nerve cells and glia. In "acute cell disease" (Nissl) and in "severe cell disease" (Nissl), there is a total cellular necrobiosis involving all subdivisions of the cells. The same is true of the "amoeboid change" and clasmatodendrosis of the glia sometimes accompanying these neuronal changes. In ischaemic nerve cell changes, the damage is essentially limited to the nucleus and cell body. Status spongiosus may be considered as an example of selective damage to intercellular glial and neuronal processes (selective processes necrobiosis). In selective nucleo-perikaryon necrobiosis and selective nuclear necrobiosis, there is a loss of affinity for anilin-dyes and increased affinity for eosin and luxol-fast blue. The structural changes that begin intravitally under conditions of oxygen deficiency continue in the dying organism for some time. This is of importance because of techniques now employed to prolong life. I.v.L.

**N64-14595***
**PATTERNS OF CNS VULNERABILITY IN CO, CYANIDE, AND OTHER POISONING**
Stephen Környey *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 165–176 refs (See N64-14580 06-16) Available from Blackwell: 70s

A survey of the field of intoxications reveals that there are pictures, which may be called "histological syndromes," that present themselves in conditions produced by a great variety of causative noxae. Therefore, in pathogenesis, a mechanism must be postulated that can become activated by different etiological factors. An identical pathomechanism is the basis of the identity of the histological process. An anoxic-vasal type of pathogenesis can be clearly defined as is proved by the essential identity of histological findings in cases of pure anoxic conditions and intoxications. To this domain belong both conditions of impaired oxygen supply and those of impaired supply of the oxidizable substrate, and finally those conditions with a sudden onset of histotoxic anoxia. Histological processes with different structures and localizations develop when oxidative processes are inhibited at certain stages of the oxidative process. I.v.L.

**N64-14596*** National Inst. of Mental Health, Bethesda, Md.
**COMMENTS ON THE SELECTIVE VULNERABILITY OF THE HIPPOCAMPUS**
Paul D. MacLean *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 177–188 refs (See N64-14580 06-16) Available from Blackwell: 70s
(NIH Grant B-2275)

Results of experiments on the selective vulnerability of the hippocampus are reviewed. It is indicated that: (1) The 3-acetylpyridine destroyed, in mice, the neurons in the same areas of the hippocampus (CA3 and CA4) that were stained by dithizone, a chelating agent that gives a reddish color when combined with zinc. (2) The 3-acetylpyridine commonly affected hippocampal areas CA3 and CA4 in the squirrel monkey but there was more consistent and severe damage to the lateral geniculate bodies and the inferior olive. The results of these experiments point to the disturbing factor of species differences in the study of the selective vulnerability of the nervous system. I.v.L.

**N64-14597*** Langley Porter Neuropsychiatric Inst., San Francisco, Calif.
**PATTERN OF CNS VULNERABILITY IN NEONATAL HYPOXAEMIA**
N. Malamud *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 211–225 refs (See N64-14580 06-16) Available from Blackwell: 70s
(NIH Grant B-377)

The pattern and the mode of distribution of lesions in chronic cases of perinatal trauma, convulsive disorders of infancy, and kernicterus were investigated. The results of the investigation tend to support the view that these disorders are distinct pathoanatomical entities. Moreover, the pattern and topography of the lesions are sufficiently characteristic in each instance to permit speculation as to its pathogenesis. In perinatal trauma the principal changes are of a circulatory nature and appear to be related predominantely to disturbed venous circulation. The lesions observed in convulsive disorders could best be defined as a hypoxaemic encephalopathy and those in kernicterus as possibly a bilirubin encephalopathy. Their occasional coexistence does not detract from their specificity. It is suggested that the concept neonatal hypoxaemia is perhaps too general to characterize accurately the pathogenesis of the disorders in question. I.v.L.

**N64-14598*** Illinois U., Chicago
**INFLUENCE OF HYPOXIA IN VARIOUS DISEASES**
O. T. Bailey *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 227–241 refs (See N64-14580 06-16) Available from Blackwell: 70s

Hypoxia plays a part in the distribution and character of lesions resulting from narrowing of cerebral arterics without occlusion in arteriosclerosis and arteriolosclerosis. When the lesions are not infarctive and tissue continuity is not destroyed, histological changes of interest in the evolution of hypoxic damage are encountered. Another problem involves the lesions in the field of distribution of occluded arteries in certain patients with the clinical syndrome of juvenile hemiplegia. The findings in two such patients are discussed in this report. There is some indication that hypoxia is concerned with the progression and spread of cerebral injury. The importance of hypoxia in the maintenance and advancement of lesions, not in themselves progressive, is also illustrated by the changes at the periphery of healing infarcts secondary to thrombosis of the superior sagittal sinus and cerebral veins, with long survival. In some instances, laminar necrosis in the adjacent cerebral cortex indicates that the deterioration of such patients is related to spreading hypoxia beyond the infarctions themselves. I.v.L.

**N64-14599*** Burden Neurological Inst., Bristol (Gt. Brit.)
**PATTERN OF SYMMETRICAL BRAIN DAMAGE**
R. M. Norman *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 243–249 refs (See N64-14580 06-16) Available from Blackwell: 70s

The pattern of the symmetrical brain damage at birth, due to hypoxic and ischaemic factors, includes the following: (1) There is a patchy disappearance of the small cells accompanied by mild fibrous gliosis in the areas of striatal marbling. The sites of predilection are the ventrolateral part of the head of the caudate nucleus and the anterior putamen. (2) The most severe neuronal losses, in the thalamus, are in the lateral nuclei. (3) There is some variation in the involvement of the globus pallidus. (4) The subthalamic nuclei are also not always involved. (5) The anygdaloid nuclei showed patchy nerve-cell loss and gliosis bilaterally in four cases, unilaterally in one case. (6) All sectors of the pyramidal cell band, in the cornu

Ammonis, may show minor damage but invariably the maximal cell losses were in the resistant sector h2. (7) The cerebellar vermis showed lobular atrophy of the more deeply placed folia in four cases, the superior vermis being involved in three of these, the anteroventral part in the other case. (8) The precentral and postcentral gyri were symmetrically atrophied in all cases studied. These central gyral changes were by far the most impressive of the lesions seen in the cerebral cortex. I.v.L.

N64-14600* National Inst. of Neurological Diseases and Blindness, Bethesda, Md.

**SELECTIVE VULNERABILITY OF THE CENTRAL NERVOUS SYSTEM OF RHESUS MONKEYS TO ASPHYXIA DURING BIRTH**

W. F. Windle *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 251–255 (See N64-14580 06-16) Available from Blackwell: 70s

This report discusses the histopathology of monkeys that were asphyxiated in their foetal membranes at Caesatean section prior to establishment of respiration—animals that were resuscitated subsequently by intratracheal administration of oxygen. Three histopathological phases are considered: (1) the structural changes in the brains of the animals partially asphyxiated although not to the point of asphyxial apnoea; (2) the structural changes in the nervous system that were visible during the 10 days after asphyxiation and resuscitation; and (3) the residual effects in the nervous system 10 months or more after asphyxiation. Also, the effects of asphyxiation in newborn and young monkeys asphyxiated with nitrogen are discussed. I.v.L.

N64-14601* Max-Planck-Institut für Hirnpathologie, Munich (W. Germany)

**TOPISTIC LESIONS**

W. Scholz *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 257–272 refs (See N64-14580 06-16) Available from Blackwell: 70s

(Contract AF 61(052)-341)

The phenomenon of laminar lesions in the cerebellar cortex and of the selective effect of hypoxaemia on the architectural fields of Ammon's horn, of the globus pallidus, and of other cerebral nuclei is discussed. I.v.L.

N64-14602* Naval Radiological Defense Lab., San Francisco, Calif.

**PARAMETERS CONTROLLING OXYGEN UPTAKE OF THE INTACT RAT LIVER – RESPIRATORY RATE AND THE DEFINITION OF HEPATIC HYPOXIA**

R. W. Brauer, G. F. Leong, R. J. Holloway, and J. S. Krebs *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 273–294 refs (See N64-14580 06-16) Available from Blackwell: 70s

The principal tool in this study was the isolated rat liver, profused through the portal vein at physiological blood pressures. The first measurements were designed to establish a baseline, and to determine the effect on hepatic oxygen uptake of varying the perfusion rate. At perfusion rates above 1.2 ml/g/min, the oxygen uptake rate of the rat liver is flow independent. As perfusion rates are lowered beyond this point, $O_2$ uptake decreases to successively lower levels. It appears that at 37.5° C the specific rate of $O_2$ consumption by the tissue is such that only cells in immediate contact with flowing blood participate in $O_2$ extraction. The lowering of the perfusion rate leads to marked reduction in oxygen uptake. Thus, it is possible to define the degree of hepatic hypoxia in terms of the ratio of the observed or predicted $O_2$ uptake rates under any given conditions to the basic $O_2$ uptake rate for the same tissue when supplied with fully oxygenated whole blood. Also, it is indicated that the isolated liver does not, in general, incur a measurable oxygen debt, as a result of prolonged exposure to levels of hypoxia at which its respiration is reduced to one-half to one-third of its basic value. I.v.L.

N64-14603 Illinois U., Chicago

**THE EFFECT OF HYPOXAEMIA ON THE METABOLIC PATTERN OF THE PERFUSED BRAIN OF CATS**

A. Geiger, G. Gombos, and S. Otzuki *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 295–304 refs (See N64-14580 06-16) Available from Blackwell: 70s

(NIH Grant B-413)

The changes in the metabolic pattern of the brain, when the oxygen tension in the blood is reduced, are reviewed. The relative rates are given at which exogenous glucose and endogenous metabolites, such as lipids, proteins, other carbohydrates, and nucleic acids contribute to the respiratory $CO_2$ and to the intermediary metabolites of the glycolytic and tricarboxylic cycles in the brain. It is indicated that some qualitative changes occur in the metabolic pattern of the brain during hypoxia, consisting mainly in the contribution of endogenous metabolites to the citric acid cycle, in addition to the quantitative changes in glucose utilization as manifested by the increase in rates of pyruvic acid and lactic acid formation. I.v.L.

N64-14604* Ludwig-Maximilians Universitat, Munich (W. Germany)

**COMMENTS ON LIVER-BRAIN CORRELATIONS IN SYSTEMIC HYPOXAEMIA**

F. Erbslöh *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 305–316 (See N64-14580 06-16) Available from Blackwell: 70s

Liver–brain correlations in systemic hypoxaemia are reviewed. It is indicated that deficient glucose utilization of the brain, in man, plays a role in the insufficient oxygen consumption in the liver. Furthermore, in view of the remarkable sensitivity of the liver to hypoxaemia, it may well be possible that, under conditions of generalized hypoxia, the metabolic changes in the liver contribute to those in the brain. I.v.L.

N64-14605* Naval Medical Research Lab., Groton, Conn.

**CYTOCHEMICAL STUDIES IN CEREBRAL HYPOXIA**

N. H. Becker *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 317–325 refs (See N64-14580 06-16) Available from Blackwell: 70s

Cytochemical studies were conducted on a rat-brain lesion. Results indicate that the pattern of the alterations of the intracellular organelles (the lysomes, mitochondria, and Golgi apparatus) is similar in both autolysis and anoxic necrobiosis. The alterations consist at first of swelling of the lysomes and mitochondria and the fragmentation of the Golgi apparatus, followed by ultimate dissolution of these structures. The lysomal changes occur early relative to those of the mitochondria and the Golgi apparatus. I.v.L.

N64-14606* Indiana U., Bloomington

**HISTOCHEMICAL AND METABOLIC CHANGES IN BRAIN TISSUE AFTER HYPOXAEMIA**

W. Zeman *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 327–348 refs (See N64-14580 06-16) Available from Blackwell: 70s

(NIH Grant B-2960-C1)

Histochemical determinations of certain oxidative and hydrolytic enzymes were performed on brain tissue of rats and monkeys with hypoxaemia. In addition, the uptake of $^{3}H$-leucine and $^{3}H$-thymidine in these tissues was studied by autoradiography. It was found that histochemical changes preceding the development of ischaemic nerve-cell necrosis consist of a swelling of the mitochondria. Moreover, protein turnover appears to be depressed. At the time of infarction, all oxidative enzymes are inactivated, whereas acid hydrolases remain in the same state as in the healthy control tissue. During the reactive phase of ischaemic nerve-cell necrosis, hydrolases are greatly enhanced in activity within mesenchymal cells, whereas oxidative enzymes are activated in proliferating astrocytes. These changes correlate with an increased ratio of thymidine-labeled nuclei of these cell species. I.v.L.

**N64-14607*** Government Hospital Tel-Hashomer (Israel)
**STUDY OF THE EFFECTS OF HYPEROXIA ON THE CENTRAL NERVOUS SYSTEM**
M. Wolman *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 349-356 refs (See N64-14580 06-16)
Available from Blackwell: 70s

Experiments were conducted on rats to test the idea that lipid peroxides play an important role in hyperoxia. Results indicate that in acute oxygen poisoning, unsaturated lipids are peroxidized and that this can cause disorganization of tissue and cell membranes. However, no direct evidence of damage to membranes was obtained, and therefore the possibility of the formation of toxic lipid remains open. In tissue slices and homogenates in which random diffusion replaces the orderly diffusion from the blood stream, it appears that changes in some tissue membranes (i.e., vascular walls) are of no great importance for normal metabolism. In such preparations, the late effect of oxygen on cellular enzymes is probably the mechanism through which cellular metabolism is inhibited. I.v.L.

**N64-14608**
**COMMENTS ON THE ENZYME HISTOCHEMISTRY OF THE NERVOUS SYSTEM**
A. G. E. Pearse *In* CIOMS Selective Vulnerability of the Brain in Hypoxaemia 1963 p 357-365 (See N64-14580 06-16)
Available from Blackwell: 70s

Comments on the enzyme histochemistry of the nervous system include the following: (1) Indoxyl techniques can be used for cholinesterases, esterases, and for some types of cathepsin. Normally these techniques can be used without selective inhibitors or activators, primarily as sensitive morphological indicators of the changing distribution of cells. With the use of inhibitors, they can be used for specific cholinesterase studies in place of the more commonly employed thiocholine techniques. (2) Some 12 oxidoreductases and 15 dehydrogenases can be demonstrated. Activity of mitochondrial $\alpha$-glycerophosphate dehydrogenase is particularly high in Ammon's horn. The activity is not in the cell bodies, however, but apparently in processes that are all traveling in the same direction. Glucose-6-phosphate dehydrogenase has been shown to be an important enzyme in brain metabolism. In the spinal cord, the enzyme's highest activity is in the posterior columns. I.v.L.

**N64-14613** Joint Publications Research Service, Washington, D.C.
**CYBERNETICS AND CONTROL THEORY**
V. I. Levenshteyn and M. V. Rybashov 14 Mar. 1963 14 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 147 no. 6, 1962 p 1300-1305
(JPRS-18127; OTS-63-21323) OTS: $0.50

CONTENTS:
1. ON THE INVERSION OF FINITE AUTOMATA V. I. Levenshteyn p 1300-1303 refs
2. SYNTHESIS OF A CLASS OF COMPUTERS M. V. Rybashov p 1304-1305 refs

**N64-14675** Emmanuel Coll., Boston, Mass. Research Language Center
**THE WAVE FILTERING PROCESS OF THE TRACHEAL OUTER WALL**
Riko Toshitaka Sugimoto, Shin-ichiro Hashimoto, and Satoshi Takahira Bedford, Mass., AFCRL Mar. 1963 9 p refs Transl. into ENGLISH from Nippon Onkyo Gakkaishi (Tokyo), 1962
(Contract AF 19(604)-8505)
(E-T-J-63-6; AD-428507)

The vocal sound wave and the vibrational wave of the tracheal outer wall were simultaneously recorded by a two-channel magnetic recorder. The speaker was an adult male, and the five Japanese vowels were used. A data translator was used for sampling of these signals. R.T.K.

**N64-14689** Stanford Research Inst., Menlo Park, Calif.
**TACTUAL PERCEPTION OF VISUAL INFORMATION**
James C. Bliss, Brian King, Kenneth Kotovsky, and Hewitt D. Crane Wright-Patterson AFB, Ohio, AF Avionics Lab., Dec. 1963 83 p refs
(Contract AF 33(657)-8824)
(ASD-TDR-63-732; AD-421511)

Psychophysical experiments aimed at determining parameters needed in the design of a tactile display containing about one hundred stimulators are reported. Also discussed are the design, construction, and performance of special equipment to control the tactile stimulators by means of programing a small digital computer. The phenomenon of apparent location was obtained with air-jet stimulation of the skin. Apparent motion was found to serve as a useful cue in temporal discriminations. Frequencies of stimulation less than 20 cps produced a pulsating sensation, whereas frequencies above 20 cps felt more like a "tone." The equipment to act as an interface between a CDC 160-A computer and an array of tactile stimulators was designed and constructed. Independent computer program routines were written to set up and perform a wide variety of experiments. R.T.K.

**N64-14695** Radiation Applications, Inc., Long Island City, N.Y.
**THE FEASIBILITY OF USING MEMBRANES FOR URINE PURIFICATION Technical Documentary Report, Jan. 1962-Jun. 1963**
Eric A. Meier and Richard Everett, Jr. Wright-Patterson AFB, Ohio, Biomed. Lab., Nov. 1963 38 p refs
(Contract AF 33(657)-9347)
(AMRL-TDR-63-113; AD-427413) OTS: $1.00

The feasibility of using synthetic membranes in an ultrafiltration process for recovering potable water from urine was demonstrated with urine specimens which had been enzymatically treated and acidified with citric acid. Specially cast cellulose acetate membranes were used in an experimental ultrafiltration system to reclaim waters which met the United States Public Health Service specifications on chloride ion and total dissolved solids. The product water was obtained at initial flux rates of approximately 10 to 20 l/ft$^2$ of filtration surface per day at operating pressures of approximately 2000 psi. A proposed design of an ultrafiltration unit is included along with a comprehensive discussion of the engineering considerations deemed significant. Author

**N64-14696** Chicago Medical School, Ill.
**A STUDY OF THE EFFECTS OF EXTERNALLY APPLIED SINUSOIDAL FORCES ON THE EYE Technical Documentary Report, 1 Mar. 1961-15 Mar. 1963**
John L. Nickerson, Anna Paradijeff, and H. S. Feinhandler Wright-Patterson AFB, Ohio, Biophys. Lab., Nov. 1963 18 p refs
(Contract AF 33(616)-7926)
(AMRL-TDR-63-120; AD-427391) OTS: $0.50

This research presents the results of investigations on the effects of externally applied sinusoidal vibrations on the eye tissues of a dog. The results are from the findings of gross autopsy, ophthalmological examination, and histological studies. Also reported are determinations of the natural resonance frequency of the eye. The possibility that deformation in the shape of the eye occurs at resonance has been explored. The methods by which these various determinations were made are described. Author

**N64-14731** Atomic Energy of Canada Ltd., Chalk River, Ontario
**LATENT IMAGE FADING IN DUPONT TYPE 555 PERSONNEL MONITORING FILM AT CHALK RIVER**
G. B. Knight and C. R. Hoffmann Sep. 1963 9 p refs
(AECL-1872; CRRD-1172) Available from Sci. Doc. Distribution Office, Chalk River, Ontario: $0.20

DuPont type 555 films enclosed in the new AECL Photobadge were irradiated and stored at temperatures and relative humidities ranging from 35° to 85° F and 35% to 75%, respectively for 1- and 2-week periods. It was concluded that the effect of latent image fading was small compared with the errors normally encountered in relating film optical density to exposure. Author

**N64-14740*** Pittsburgh U., Pa. School of Medicine
**MICROSPECTROPHOTOMETRY**
J. J. Wolken and G. K. Strother Repr. from Appl. Optics, v. 2, no. 9, Sep. 1963 p 899-907 refs
(NASA Grant NsG-230-62)

Manual and recording microspectrophotometers have been constructed with cadmium selenide (CdSe) photoconductive cells and are in use as a spectroscopic tool in the study of the pigment chemistry of photoreceptors in living cells. The basic design and operation of these microspectrophotometers for obtaining absorption spectra are described. The absorption spectrum from the ultraviolet, visible, and near infrared can be obtained in a single sweep for specimen areas as small as 2 $\mu^2$. Examples of absorption spectra of the chloroplast of plant cells, the retinal rods of the visual cells of the eye, and the red blood cell are given. The applications of microspectrophotometry to a variety of biological, biochemical, and chemical problems are indicated. Author

**N64-14741*** California U., Berkeley Space Sciences Lab.
**EVIDENCE FOR LIFE ON MARS**
D. G. Rea Repr. from Nature (London), v. 200, no. 4902, 12 Oct. 1963 p 114-116 refs
(NASA Grant NsG-101-61)

Observations are presented to illustrate the point that the evidence in support of the chance for the existence of life on Mars has been distorted and that a reexamination is required. The observational arguments for the existence of Martian life are: the various colors, including green, exhibited by the dark areas; the seasonal changes in the visual albedo and the polarization of the dark areas; the ability of the dark areas to regenerate after an extensive dust storm; and the presence of 2700 to 3000 $cm^{-1}$ absorption bands, attributed to organic molecules. Aspects of Mars are given that defy the existence of life, and include the severity of the Martian climate. C.L.W.

**N64-14750** Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
**DATA PROCUREMENT AND PROCESSING FOR THE FISSION PRODUCT INHALATION PROGRAM USING AN AUTOMATIC READ OUT COUNTING SYSTEM Technical Progress Report**
R. M. Goodrich and R. G. Thomas Dec. 1963 27 p ref
(Contract AT(29-2)-1013)
(LF-13) OTS: $0.50

An automatic readout counting system is in use which allows the radioactivity information from the scaling system to be transmitted directly to punched tape and/or typewriter. Additional sample information, such as tissue identification and weight, counting time, experiment number, etc., is preset with thumb-wheel switches into a data input box. Readout of the data input box just precedes scaler readout, the signal for which is given by the end of preset counting time. The punched tape is converted to cards which are stored until completion of an experiment. At this time the information is used in a program to compute the necessary parameters for final distribution and excretion analysis. When desired, the computer plots the radioactivity data from any given series of tissue or whole body determinations and yields the constants of the least squares equations. Integration of the function may also be performed for dosage determination. Author

**N64-14779** Frost Engineering Development Corp., Denver, Colo.
**HUMAN BODY DYNAMICS UNDER SHORT-TERM ACCELERATION**
Peter R. Payne and Earnest L. Stech 26 Jun. 1962 67 p refs
(Tech. Rept. 115-2; AD-429027) OTS: $6.60

A dynamic mathematical model of the human body is presented that permits assessment of the loads imposed on the body during any type of acceleration time history. This model also permits, for the first time, an adequate definition of human tolerance to acceleration, and allows the prediction of the gross motion of the human body when subjected to accelerations. I.v.L.

**N64-14810** Mississippi State U., State College
**PHYSICAL, CHEMICAL AND MICROBIOLOGICAL EVALUATION OF ELECTRO-CHEMICAL DEGRADATION OF HUMAN WASTES Informal Progress Report No. 6, 1 Oct.-31 Dec. 1963**
[1964] 25 p refs
(Contract AF 41(609)-1633)
(AD-429062) OTS: $2.60

Six metals were employed as electrodes to determine their utility in the breakdown of DO during electrolysis. Gold, indium, and vanadium were unsatisfactory. Iridium, palladium, and rhodium destroyed the DO during electrolysis but at a much slower rate than platinum. When these metals were employed as the cathodes with platinum as the anode, no improvement was noted in the time required for decolorization of the DO, but anode weight losses were considerably smaller. Studies of the growth rate of Chlorella 71105 in EDO and in Knop's medium were conducted. EDO yielded only half as much growth as the Knop's medium in a 96-hour period. Urine enriched EDO produced results equal to the Knop's medium. Growth studies were conducted utilizing EDO resulting from the use of cobalt, gold, indium, iridium, nickel, palladium, rhodium, vanadium, and zirconium. Author

**N64-14832** University Coll., Galway (Ireland)
**STUDY OF THE PROPERTIES AND STRUCTURE OF PURIFIED MAMMALIAN ADENOSINE DEAMINASE ISOLATED FROM CALF INTESTINE Quarterly Technical Status Report No. 7, 1 Jul.-30 Sep. 1963**
Thomas G. Brady et al Oct. 1963 5 p
(Contract DA-91-591-EUC-2901)
(AD-429070)

Experimental procedures included the purification of adenosine deaminase from calf mucosa and cat lung, the attempted separation of the isozymes of adenosine deaminase by starch block electrophoresis, and the investigation of some tissue for their isozyme content. Thirteen animals have been examined to date. While considerably more organs will have to be investigated in both the cat and calf before definite conclusions can be reached, it does appear that the cat has considerably more uniformity of isozyme content than the calf. J.E.T.

**N64-14866*** National Aeronautics and Space Administration, Washington, D.C.
**NASA PROGRESS IN LIFE SCIENCES**
Hugh L. Dryden [1964] 20 p Presented at the 5th Annual Lectures in Aerospace Med., Brooks AFB, Tex., 3 Feb. 1964
(NASA TM X-51344) OTS: $1.60 ph, $0.80 mf

One of the major accomplishments of Project Mercury was in the area of biomedicine. Bioinstrumentation measured respiration by means of a thermistor (rectal temperature) and EKG, using a two-lead electrocardiograph. With Glenn's flight came additional improvements, such as the addition of blood pressure to the reactions to be measured. From this flight, it was learned that disorientation is not a problem of consequence. Also, during the course of the Mercury Project flight series, it became apparent that a very important index of astronaut performance and well-being was astronaut voice communication. This, coupled with the astronaut's subjective physiological observations, served as a validation of the physiological training that had been given. A trend analysis of Mercury data seems virtually to exclude the presence of acute ill effects due to short-duration weightlessness, but it also seems to establish that the effects of weightlessness upon man are very probably a function of time duration. I.v.L.

**N64-14880** California U., Livermore. Lawrence Radiation Lab.
**HAZARDS CONTROL Quarterly Report No. 14, Jul.-Sep. 1963**
[1963] 76 p refs
(UCRL-7571) OTS: $1.75

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**N64-14898*** Texas Woman's U., Denton Nelda Childers Stark Lab. for Human Nutrition Research
**FUNDAMENTAL INVESTIGATION OF LOSSES OF SKELETAL MINERAL IN YOUNG ADULT HUMAN MALES AND COLLATERALLY IN YOUNG ADULT MALE PIGTAIL MONKEYS (MACACUS NEMESTRIMA) THROUGH IMMOBILIZATION FOR VARYING PERIODS OF TIME, COUPLED WITH A STUDY OF METHODS OF PREVENTING OR REDUCING MINERAL LOSS Semiannual Report [1 Apr.-30 Sep. 1963]**
Pauline Beery Mack et al 30 Sep. 1963 50 p
(NASA Grant NsG-440)
(NASA CR-55313) OTS: $4.60 ph, $1.70 mf

Two bed rest studies were conducted. Measurements of radiographic bone densitometry and analyses of calcium and phosphorus in the urine were made. The first of the two studies has shown that bed rest of as short a time as 3 days was followed by a loss in bone mass in the oscalcis in all human subjects. After a 10-day interim period, a second 3-day bed rest period, in which controlled isometric exercise was given produced a bone mass status in the central section of the oscalcis that was significantly increased. In an initial primate study, bone mass in numerous parts of the body, as measured from radiographs, was significantly higher following a period in which vigorous exercise was taken under direction. Balance studies accompanied the radiographic measurements. E.W.

**N64-14924** Hanford Atomic Products Operation, Richland, Wash.
**EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD, JULY-SEPTEMBER, 1963**
R. F. Foster 15 Nov. 1963 32 p refs
(Contract AT(45-1)-1350)
(HW-79652) OTS: $1.00

Comprehensive surveillance of the occurrence of radioactive materials in air, water, and foodstuffs was continued in the vicinity of the Hanford plant. Natural background radiation, with some contribution from worldwide fallout, continued to be the primary source of environmental exposure. The largest contribution of radioactive material continued to be the highly dilute low-level waste in the reactor cooling water discharged to the Columbia River. Exposure from the various sources, summed in a manner that tends to maximize the total dose to an individual, were estimated to be about 10% of the Federal Radiation Council (FRC) guide for the total body, 30% of the FRC guide for a child's thyroid, and about 30% of the National Committee on Radiation Protection and Measurements (NCRP) maximum permissible rate of intake for bone-seeking radionuclides. Author

**N64-14944** Joint Publications Research Service, Washington, D.C.
**CYBERNETICS AND THE NERVOUS SYSTEM**
G. Caclaianu (Rumanian Acad. of Sci.) 14 Feb. 1964 18 p refs Transl. into ENGLISH from Studii Cercetari Neurol. (Bucharest), v. 8, no. 3, 1963 p 325–335
(JPRS-23234; OTS-64-21562) OTS: $0.50

The relationship of cybernetics to science and technology, neurology, pathology, mathematics, logic, and philosophy is discussed. R.T.K.

**N64-14952** Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
**INFLIGHT LOSS OF CONSCIOUSNESS, A CASE REPORT**
Pei Chin Tang and J. Robert Dille Sep. 1963 15 p refs
(CARI-63-21)

A case of in-flight vertigo and loss of consciousness in a private pilot, flying alone, is presented. The differential diagnosis and the significance of the findings of 5 to 7 per second theta waves in the resting EEG and high voltage slow waves during caloric irrigation of the right ear are discussed. Author

**N64-14966** Washington, U., Seattle
**ANALOG COMPUTER SIMULATION OF TEMPERATURE REGULATION IN MAN Technical Documentary Report, Oct. 1960–Dec. 1962**
Arthur C. Brown Wright-Patterson AFB, Ohio, Biomed. Lab., Dec. 1963 114 p refs
(Contract AF 33(616)-7342)
(AMRL-TDR-63-116; AD-428144) OTS: $2.50

The mathematical equations for temperature distribution were derived from the physical principles describing heat flow, first in the form of integral equations and the corresponding vector differential equations, and then in the form of difference differential equations appropriate for electronic simulation. From these equations, a model of the body was constructed involving four concentric thermal elements. The equations describing the behavior of the thermal elements were simulated electronically. Feedback loops representing the analog of control of metabolism and vasomotor state were introduced into the model, simulating the human temperature regulation system. Solutions were generated by the computer under the specific condition of cold-water immersion for varying clothing insulation and environmental (water) temperature. The computer predictions were found to be in relatively good agreement with preliminary experimental work. Author

**N64-14971** Jewish Hospital of Brooklyn, N.Y.
**EXPLORATION OF THE VAPOR PHASE ULTRAVIOLET SPECTRA OF THE HORMONES FROM THE ADRENAL AND RELATED SUBSTANCES**
Samuel Natelson and John Bonas Holloman AFB, N. Mex., 6571st Aeromed. Res. Lab., Dec. 1963 91 p refs
(Contract AF 29(600)-3337)
(ARL-TDR-63-29; AD-402417)

The absorption spectra for certain steroid and catechol derivatives in the range from 185 to 300μ in the vapor state are compared to the absorption spectra of these compounds observed in solvents. It is pointed out that better resolution and higher sensitivity are observed in the vapor state. Elevated temperatures are used to vaporize these compounds, and a practical cuvette and heating means are described for this purpose. At elevated temperatures certain bands visible at low temperatures are wiped out in the range of approximately 230μ. However, other bands of high degree of absorptivity appear at from 185 to 210μ. The spectra of derivatives of desoxy corticosterone, cortisone, estradiol, estrone, veratrole, and vanillin are explored in this study. Author

# 17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

**N64-14202** Chicago U., Ill. Chemical Engineering Div.
**LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID BED FLUORIDE VOLATILITY PROCESSES. PART 4, THE FLUID BED FLUORINATION OF $U_3O_8$**
R. L. Jarry, A. V. Hariharan, G. Manevy, J. Fischer, and J. J. Stockbar Argonne Natl. Lab., Oct. 1963 26 p refs
(Contract W-31-109-eng-38)
(ANL-6763, Pt. 4)

Experiments were performed to determine the optimum reaction conditions for the conversion of $U_3U_8$ to uranium hexafluoride and for minimizing the elutriation of unreacted $U_3O_8$ from the fluid bed. Elutriation of $U_3O_8$ from the fluid bed was minimized when a fluid bed height of 8 in. of 120 mesh alumina, a fluorinating gas phase containing 20 v/o fluorine, and a reaction temperature of 500° C were employed. Conversion of greater than 99 percent of the $U_3O_8$ to uranium hexafluoride was obtained when the feeding-fluorination period (in which the $U_3O_8$ powder was fed into the fluid bed and the major part of the fluorination was accomplished by reacting the oxide with 20 v/o fluorine) was followed by a recycle-fluorination period of 5 hr at 500° C with 100 percent fluorine. Kinetic data for the fluorination of $U_3O_8$, obtained by means of a thermobalance, are reported for the temperature range from 300° to 400° C. The data were treated by the diminishing-sphere model. Experimental results are also presented for the oxidative decladding of stainless steel-clad and Zircaloy-clad uranium dioxide pellets. Author

**N64-14217** Franklin Inst., Philadelphia, Pa. Labs. for Research and Development
**SURVEY OF COMPONENT REQUIREMENTS AND AVAILABILITY FOR GAS-COOLED NUCLEAR REACTOR POWER PLANTS: VESSELS AND SUPPORTS, VALVES, EXPANSION JOINTS, AND PIPES**
Georgs Novickis Oct. 1962 710 p refs
(Contract AT(30-1)-2512)
(NYO-9788; I-A2392-3) OTS: $7.50

This report, a result of a literature survey and responses from manufacturers, was written to assess the state of the art in design requirements and the availability of reactor pressure vessels and supports, valves, expansion joints, and piping for primary circuits in gas-cooled reactors. Seventy-nine reactors are listed. The equipment mentioned for these reactors is described and discussed, and lists of manufacturers are included. Author

**N64-14244** Bureau of Mines, College Park, Md. Metallurgy Research Center
**CADMIUM REFINING BY AMALGAM ELECTROLYSIS**
Arnold Marshall Lansche and D. H. Chambers 1964 21 p refs
(BM-RI-6352)

Electrorecovery by amalgam methods was investigated to determine the feasibility of recovering pure cadmium from cadmium sponge produced during purification of zinc electrolyte at electrolytic zinc plants. Actual material used in this work was air-oxidized cadmium sponge. An acid rinse and zinc displacement technique was developed to amalgamate this oxidized cadmium. Zinc was completely removed from amalgamated sponge by selective oxidation with air. Zinc-free cadmium amalgam was circulated by an electromagnetic pump through an electrolytic cell where cadmium of 99.9+ percent purity was electrodeposited onto a rotating aluminum cathode. Polarographic methods were developed for determining cadmium and zinc in mercury and in sulfuric acid solution. Author

**N64-14245** Bureau of Mines, Reno, Nev. Metallurgy Research Center
**CONTINUOUS ELECTROWINNING OF CERIUM METAL FROM CERIUM OXIDES**
Edward S. Shedd, J. D. Marchant, and T. A. Henrie 1964 16 p refs
(BM-RI-6362)

Cerium metal was electrowon in a fluoride bath from cerous oxide and tapped from the cell during prolonged operation. Electrolyte constituents were $CeF_3$, $BaF_2$, and LiF. Twenty-seven pounds of metal of 99.8-percent purity were produced at a rate of 3 pounds per hour and tapped from the cell. Principal impurities were molybdenum, aluminum, oxygen, and carbon. The operating parameters, such as electrode geometry, bath compositions, and oxide feed rate, were investigated. Anode reactions were found to be important factors in cell operation. Stable cerous oxide reacted more uniformly at the anode surface than ceric oxide. Electrowinning was conducted in crucible hearths consisting of both frozen electrolyte and molybdenum metal. Both materials proved satisfactory and did not react with the molten cerium. Author

**N64-14257** Joint Publications Research Service, Washington, D.C.
**CRYSTALLIZATION OF INGOTS DURING ARC MELTING WITH A CONSUMABLE ELECTRODE**
V. I. Dobatkin 4 Feb. 1964 16 p refs Transl. into ENGLISH of an article from Issled. Splavov Tsvetn. Metal. Akad. Nauk SSSR, Inst. Met. (Moscow), no. 4, 1963 p 117-129
(JPRS-23056; OTS-64-21473) OTS: $0.50

The conditions for producing ingots in arc melting are discussed, and the chief regularities in crystallization of ingots established for arc melting using a consumable electrode are enumerated: (1) The depth of the liquid pool of the crystallizing ingot is directly proportional to current during melting. (2) A liquid bath deviates in form from a regular cone (it is usually cup shaped. (3) The linear rate of ingot crystallization averaged over ingot cross section decreases with increase in ingot cross section and increases with increased buildup rate. (4) Heating by means of arc heat leads to considerable over-heating of the exposed ingot surface and a high-temperature gradient within the liquid bath. (5) The zone of columnar structure in the ingot increases with increased current strength during melting. An evaluation of some factors that externally influence ingot crystallization is also presented. P.V.E.

**N64-14284*** Marlin-Rockwell Corp., Jamestown, N.Y.
**METHOD OF PRODUCING IMPROVED BEARING COMPONENTS BY ELIMINATION OR CONTROL OF FIBER ORIENTATION Final Report**
James M. Hopkins 15 Nov. 1963 100 p refs
(NASA Contract NASw-72)
(NASA CR-55402) OTS: $8.60 ph, $3.20 mf

Tests of steel balls produced by various methods of manufacture, intended to reduce end fiber areas, gave varying results, which indicated the importance of other variables that require control before the effects of end fiber can be completely analyzed. Additional experimentation was directed to an evaluation of the effect of nonmetallic inclusions and rate and magnitude of plastic deformation in material processing, as well as continued fiber-orientation studies. Three lots of balls have shown a significant improvement in fatigue life. One lot, peened at room temperature in the prehardened condition, showed a significant reduction in life scatter. A second lot, manufactured to obtain high silicate nonmetallic inclusions, showed a significant reduction in the frequency of spalling of end fiber areas accompanied by exceptional average fatigue life of normal scatter. The third lot, containing high aluminate nonmetallic inclusions, showed a significant improvement in the fatigue life of end fiber material. Author

**N64-14299** National Semiconductor Corp., Danbury, Conn.
**PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND INCREASE THE RELIABILITY OF THE 2N328A TRANSISTOR Quarterly Progress Report No. 1, 30 Jun.-30 Sep. 1963**
R. R. Rau 1963 35 p refs
(Contract DA-36-039-AMC-01480(E))
(AD-427668)

Progress is reported in the following areas: (1) The etch wheel is being fabricated. (2) The recirculator has been installed. (3) Preliminary evaluations of a can welding shield give indications of improvements to be expected for this type of activity. (4) Step-stress testing with power dissipation as the stress has been almost completely evaluated as a convenient monitor to verify reliability improvements to be expected from the equipment and process improvements. Author

**N64-14319** Automation Industries, Inc., Boulder, Colo.
**INVESTIGATION OF METHODS FOR DETERMINING ACTUAL FLAW SIZE IN MATERIALS BY NONDESTRUCTIVE ULTRASONIC MEANS Technical Report, 15 Nov. 1961-18 Aug. 1962**
Leo J. Anderson, Marvin R. Wick and G. J. Posakony Wright-Patterson AFB, Ohio, AF Materials Lab., Nov. 1963 91 p
(Contract AF(616)-7279, S2(61-1519))
(ASD-TR-61-205, Pt. 2; AD-425535)

A breadboard instrument that presents an isometric, 3-dimensional, volumetric projection of inconsistencies in metal parts has been developed. This instrument represents a new technology using sound beam properties in materials as operating parameters to produce an isometric presentation on a cathode ray tube. The instrument is capable of rapid scan rates, analysis by in-process viewing, and flaw area localization. Author

**N64-14338** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**REMOVAL OF SLUDGE FROM BOILER UNITS**
M. Ya. Polyanskiy and K. A. Blinov *In its* Heat Power Eng., Selected Articles 11 Oct. 1963 p 1-12 refs (See N64-14337 06-01)

The composition of boiler sludge is discussed. The advisability of using a magnetic field for the deposition of boiler sludge was substantiated. A combined-type sludge remover, which is placed in the circulation contour and is based on the use of gravitational, centrifugal, and magnetic field forces, was also developed. R.T.K.

**N64-14381** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**VACUUM PLATING OF REFRACTORY METALS**
R. A. Ul'yanov, N. D. Tarasov, and S. F. Kovtun 7 Oct. 1963 8 p refs Transl. into ENGLISH from Tsvetn. Metal. (Moscow), no. 3, 1963 p 74–76
(FTD-MT-63-98/1+2+3+4; AD-428554) OTS: $1.10

Plating of refractory metals was done on a vacuum rolling mill. As a result of the investigations, it was found that joint rolling of identical metals at reductions of 30% to 40% in temperature leads to their full welding. In the contact zone, recrystallization occurs with a disappearance of the texture of deformation, and durability of bonding approaches that of the durability of connected metals. In the case of unlike metals, the structure of the contact zone, and consequently, the durability of bonding were found to depend on the character of the interaction between the metal of the coating and the plated metal. A 2-hr soaking at 1200° C of molybdenum and niobium, plated with chrome-nickel alloys, had little influence on the structure and durability of bonding. Soaking for 10 hours at that same temperature lead to a 15% to 20% increase in durability. R.T.K.

**N64-14388** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**CENTRIFUGAL PUMPS**
V. I. Kiselev 10 Oct. 1963 4 p Transl. into ENGLISH from the Publ. "Nasosyi Kompressor Ventilyatory", Moscow, 1959 p 144–145 and 171
(FTD-TT-63-940/1; AD-428629) OTS: $1.10

The operating principle and the arrangement of centrifugal pumps are discussed. The centrifugal pump is first described in terms of its basic parts, and a review of its working principle follows. C.L.W.

**N64-14396** Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
**HEAT AND MASS TRANSFER IN A TURBINE CONTACTOR**
Donald S. Webster Dec. 1963 37 p refs
(Contract AT(07-2)-1)
(DP-847) OTS: $0.75

The performance of mixer–settlers for transfer of a solute between immiscible liquids cannot yet be closely defined. One cause of unpredictability, namely, the variable existence of circulation within drops of the dispersed phase, is reported here. The mixing volume in a turbine contactor and a composite of published drop size measurements indicated that heat transfer could be ascribed to a mixture consisting of rigid drops. However, the rate during mass transfer in the contactor was about 50 times greater than that calculated for a system of rigid drops, and it was necessary to postulate circulation within drops to correlate the data. A criterion for the occurrence of circulation and a method for calculating the velocity of circulation were developed and used to predict mass transfer coefficients. Author

**N64-14444** Aeronautical Research Labs., Melbourne (Australia)
**AN EXPERIMENTAL SEMI-AUTOMATIC JIG FOR WINDING STRAIN GAUGES**
S. W. Gee Jul. 1963 15 p
(ARL/SM-119)

A semiautomatic strain-gage winding jig was designed with a view to increasing the production of flat-grid strain gages and to simplifying the winding process, so that relatively unskilled operators could be employed to wind gages of acceptable reliability. An experimental jig was constructed which showed sufficient promise to justify the construction of production models of the jig. Strain gages of fixed gage length but of different widths and resistances were readily wound on the experimental jig. Author

**N64-14510** Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
**VACUUM ARC MELTING OF EXPERIMENTAL REFRACTORY METALS**
Shingo Inouye Nov. 1963 28 p refs
(RTD-TDR-63-4089; AD-426688)

The influence of furnace design modifications and melt variables on electrode melt rates is shown. Minor additions of oxygen and titanium to tungsten electrodes reduce the melt rate, and additions of carbon and zirconium cause no significant change in melt rate. Increased melting current also increases electrode consumption rate. In general, coarser macrostructures are associated with slower melt rates. Author

**N64-14541** Los Alamos Scientific Lab., N. Mex.
**PREPARATION OF AMERICIUM METAL**
K. W. R. Johnson and J. A. Leary 21 Jan. 1964 18 p refs
(Contract W-7405-eng-36)
(LA-2992)

This report summarizes the first preparation of Am metal on a macroscopic scale. A total of 22.5 g of Am metal was prepared in three reductions by the reaction of $AMO_2$ with La in vacuo. The products from two of the three reductions were cast into ingots, the largest ingot weighing 10.5 g. Average overall yield was 74%. Author

**N64-14637** Naval Air Development Center, Johnsville, Pa. Aeronautical Electronic and Electrical Lab.
**EVALUATION OF WELDED CONNECTIONS FOR AIRBORNE ELECTRONIC EQUIPMENT Phase Report**
S. R. Picard 2 Feb. 1962 11 p
(NADC-EL-61121; AD-273632)

Evaluation studies led to the following conclusions: (1) At the present time an absolute nondestructive test for welded connections does not exist. (2) Many materials are weldable, but all require determination and control of optimum energy and pressure to insure that a good metallic bond has been obtained in the welded connector. (3) The most desirable lead diameters are in the range from 0.010 to 0.032 in. (4) The length of the component lead has no effect on the welded connection. (5) The overall cost per unit of welded modules appears to be slightly higher than printed circuit boards. Other advantages of welded modules, which tend to offset their higher cost, include higher component density, expendable packaging, rapid construction, increased structural strength, and increased reliability. Author

**N64-14811** Aeroprojects Inc., West Chester, Pa.
**ULTRASONIC WELDING OF REFRACTORY METALS AND ALLOYS WITH POWER-FORCE PROGRAMMING Final Report**
Nicholas Maropis and John G. Thomas Dec. 1963 115 p refs
(Contract NOw-63-0125-c)
(Res. Rept. 63-66; AD-427997) OTS: $9.60

Equipment was assembled for ultrasonic welding with power-force programing. Preliminary welding of 2024-T3 aluminum alloy and Inconel X-750 showed significant weld strength improvement with power-force programing. Significantly improved weld strengths and lower strength variability were obtained with power-force programed welding of 0.010-in. and 0.013-in. molybdenum–0.5% titanium alloy and with 0.015-in. B-66 niobium alloy. Author

**N64-14873** Metcut Research Associates, Inc., Cincinnati, Ohio
**MACHINING MOLYBDENUM-TZM ALLOY**
Repr. from ASD-TDR-63-581, Jul. 1963 p 78-101
(Contract AF 33(600)-42349)

Two alloys of molybdenum are selected for machining tests—the titanium-zirconium alloy known as TZM and the molybdenum-0.5% titanium alloy. Typical microstructures of these alloys are shown, and their nominal chemical compositions are given. The machining includes turning tests, face milling tests, end milling, drilling, reaming, tapping, and grinding. C.L.W.

**N64-14877** Joint Publications Research Service, Washington, D.C.
**APPLICATION OF SCIENTIFIC AND TECHNICAL ACHIEVEMENTS IN PRODUCTION**
Stefan Nadasan 6 Feb. 1964 9 p Transl. into ENGLISH from Stiinta si Tehnica (Bucharest), no. 12, Dec. 1963 p 3-5
(JPRS-23116; OTS-64-21505) OTS: $0.50

The application of scientific and technical achievements in production includes the following: (1) The calculation of the power balances during high power and fuel consuming investigations brought out the possibility of reducing power consumption either by technical organizational measures or by improvements in the technological installations. (2) A device with radioactive isotopes was installed at a synthetic fiber and thread plant for automatic regulation and optical and acoustical signalization of the level of the mercury oven. (3) The study of the properties of rare metals with semiconductor qualities, for example, on germanium, has made possible the construction of diodes and other semiconductor elements for the development of electronics, automation elements, computers, etc. (4) Digital and analog computers have been used to study the optimum distribution of power in the national electric power system. (5) Aeromechanical research has led to the realization of boats for harvesting reeds. (6) A machine was developed for testing the wear in contact plates used in radio and television sets. (7) Rolled cylinders are being produced with an approximate 40% greater durability than imported cylinders cast from alloyed pig iron. I.v.L.

**N64-14878** Joint Publications Research Service, Washington, D.C.
**COLD- AND HOT-WORKING OF REFRACTORY METALS**
6 Feb. 1964 15 p refs Transl. from RUSSIAN into ENGLISH (JPRS-23121; OTS-64-21508) OTS: $0.50

CONTENTS:

1. CHANGE OF ELECTRON WORK FUNCTION DURING COLD-WORKING OF MOLYBDENUM AND TANTALUM IN A SUPER-HIGH VACUUM L. A. Andreyev and Ya. Palige p 1-5 refs

2. HIGH-TEMPERATURE DEFORMATION OF REFRACTORY METALS V. L. Orzhekhovskiy, I. M. Pavlov, Ya. B. Gurevich, and A. Ye. Shelest p 6-12 refs

**N64-14973** Aro, Inc., Arnold Air Force Station, Tenn.
**THE PUMPING OF GAS MIXTURES WITH COMBINATIONS OF PUMPING SYSTEMS IN A SPACE CHAMBER**
C. E. Cheeseman and N. C. Latture Arnold Eng. Develop. Center, Feb. 1964 31 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-260; AD-428915)

The pumping systems evaluated consisted of 350 $ft^2$ of 77° K cryosurfaces, two separate configurations of 20° K cryosurfaces, two $LN_2$-baffled 32-in. diffusion pumps, and a titanium evaporation pump. Gas inputs were mixtures of nitrogen, hydrogen, and water vapor. Chamber pumping speeds in the $10^{-6}$- to $10^{-8}$-torr region for individually admitted gasses were $3 \times 10^5$ $\ell$ sec for $H_2O$, $3 \times 10^4$ $\ell$ sec for $H_2$, and $2.5 \times 10^5$ $\ell$ sec for $N_2$ when a 40 $ft^2$, 20° K cryopanel was used with the 77° K surfaces and the diffusion pumps. Increases of from 50 percent to 1,000 percent in $H_2$ pumping speed were achieved by the utilization of the titanium evaporation pump. This pump demonstrated a decrease in $H_2$ pumping speed in the presence of other gases attributable to poisoning of the fresh titanium surface. Increases in $N_2$ pumping speeds were observed to result from increased $H_2O$ vapor input caused by water-frost cryotrapping effects. Author

**N64-14989** Radio Corp. of America, Harrison, N.J.
**PRODUCTION ENGINEERING MEASURE FOR TUBE TYPE 7587 Sixth Quarterly Progress Report, 1 Sep. 1963-30 Nov. 1963**
W. Ackermann [1963] 20 p
(Contract DA-36-039-SC-86732)
(AD-428538)

The truss grid and exhaust machines have achieved production levels of output and are in regular, scheduled factory use. The lead loader and copper washer machines were debugged, tested, and are ready for production use. The preproduction samples were fabricated. Author

# 18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

**N64-14212*** General Dynamics Corp., San Diego, Calif. General Atomic Div.
**COMPATIBILITY OF URANIUM-BEARING NUCLEAR FUELS AND REFRACTORY-METAL THERMIONIC EMITTERS**
M. Harlan Horner, A. F. Weinberg, and L. Yang *In* Inst. of Elec. and Electron. Engr. Rept. on the Thermionic Conversion Specialist Conf., Oct. 7-9, 1963 p 257-265 refs (See N64-14204 06-01) GE Res. Lab., $15.00
(NASA Contract NAS3-2532; Contract AT(04-3)-167)

Previously reported studies of the compatibility of UC, UZrC, and $UO_2$ with tungsten, molybdenum, tantalum, and niobium have been extended to include rhenium, iridium, and the tungsten-base alloys W-26 wt-% Re, W-15 wt-% Mo, and W-2 wt-% Mo. The temperature of prime interest has been 1,800° C, but the studies have included temperatures as low as 1,200° C. In addition to short-term testing of conventional diffusion couples, tests have been conducted for times up to 1,100 hr, using both conventional techniques and the monitoring of vacuum electron emission from a clad fuel pellet as a means of detecting diffusing fuel components. Author

**N64-14227** Hanford Atomic Products Operation, Richland, Wash.
**NEUTRON DAMAGE TO METALS**

H. E. Kissinger, J. J. Laidler, B. Mastel, and G. E. Miller *In its* Met. Res. Operation 15 Oct. 1963 p 3.1–14 refs (See N64-14226 06-01) OTS: $3.50

The studies described were directed toward establishing the combined effect of impurities and neutron irradiation on the properties and structure of specific metals, and deducing from thermally activated recovery processes the manner in which the damaged state can be altered. Single and polycrystalline specimens of Mo, Ni, and Re were used. Results of studies in the following areas are included: transmission electron microscopy, X-ray diffraction, micrography, mechanical properties, and field ion microscopy. R.T.K.

**N64-14229** Hanford Atomic Products Operation, Richland, Wash.

**PLUTONIUM PHYSICAL METALLURGY**

R. D. Nelson, F. E. Bowman, G. E. Miller, C. R. Becker, and H. E. Kissinger *In its* Met. Res. Operation 15 Oct. 1963 p 3.35–60 refs (See N64-14226 06-01) OTS: $3.50

Investigations were conducted in order to determine the properties of high-purity unalloyed and alloyed plutonium. The unique structure of several of the plutonium allotropes and their narrow temperature span of stability were investigated. The following were studied: phase transformation strain; thermal cycling damage; mechanisms of the B$\alpha$ transformation; deformation and fracture mechanisms, recovery, recrystallization, and grain growth; texturing in rolled alpha plutonium; electron microfractography; and optical metallography. R.T.K.

**N64-14230** Hanford Atomic Products Operation, Richland, Wash.

**ALLOY SELECTION**

T. T. Claudson *In its* Met. Res. Operation 15 Oct. 1963 p 4.1–44 refs (See N64-14226 06-01) OTS: $3.50

Investigations were made to determine the effect of irradiation on reactor metals—both the steel alloys being used in existing reactors and those alloys whose properties indicate they may be suitable for future reactors. The fabrication histories of the specimens under consideration are included. R.T.K.

**N64-14231** Hanford Atomic Products Operation, Richland, Wash.

**IN-REACTOR MEASUREMENTS OF MECHANICAL PROPERTIES**

J. J. Holmes, D. H. Nyman, and J. A. Williams *In its* Met. Res. Operation 15 Oct. 1963 p 4.45–49 refs (See N64-14226 06-01) OTS: $3.50

In-reactor creep properties of Zircaloy-2 were studied. Results of tests on 20% cold-worked Zircaloy-2 at 35,000 and 25,000 psi stress at 320° and 365° C, respectively, are reported. R.T.K.

**N64-14322** IIT Research Inst., Chicago, Ill.

**IMPROVED PRODUCTION OF POWDER METALLURGY ITEMS Interim Progress Report, 1 Oct.–31 Dec. 1963**

K. Farrell and N. M. Parikh 1963 17 p
(Contract AF 33(657)-9140)
(ASD-TDR-7-911(VI); AD-428197)

The difficulties encountered in upscaling production of atomized superalloy powders from a laboratory scale to commercial quantities are outlined. Ways of overcoming the difficulties are described. Tests on sintered powder billets of Udimet 700 and Inco 713C alloys show that the billets can be readily forged. The mechanical properties of the forged Udimet 700 powder compact compare very favorably with those of the conventional wrought product. The mechanical strengths of Inco 713C alloy, which is usually considered unforgeable, are found to be twice as high as those of the conventional cast material. Author

**N64-14346** Aerospace Corp., El Segundo, Calif. Materials Science Lab.

**THE MICROPLASTIC BEHAVIOR OF POLYCRYSTALLINE NICKEL**

R. D. Carnahan and J. E. White 6 Jan. 1964 35 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-348; TDR-269(4240-10)-5; AD-427348) OTS: $3.60

A study was undertaken to determine the deformation behavior of polycrystalline nickel of grain sizes from 0.018 to 0.44 mm in the microstrain region. Deformation was observed to begin at stresses of ~200 psi or 0.1 of the critical resolved shear stress (CRSS) for single crystals. Deformation proceeded in annealed samples by three well-developed stages, the nature of each of which was influenced by prior thermomechanical treatments. The microflow stress in the third stage obeyed a Petch type of grain size dependence; no parabolic hardening behavior was observed. A micro-Bauschinger effect was observed that may be related to the lattice resistance to free dislocation motion. Author

**N64-14356** MSA Research Corp., Callery, Pa.

**FACTORS AFFECTING THE COMPATIBILITY OF LIQUID CESIUM WITH CONTAINMENT METALS Quarterly Progress Report No. 5, Sep.–Nov. 1963**

F. Tepper and J. Greer 15 Dec. 1963 19 p refs
(Contract AF 33(657)-9168)
(MSAR 63-172; AD-428397) OTS: $1.60

A device for the determination of the solubility of carbon in cesium is presently being constructed. Solubility studies of the alloys Haynes-25, niobium-1% zirconium, and molybdenum-0.5% titanium in liquid cesium are continuing, and preliminary rates are given for Haynes-25. Investigation of the mechanisms associated with attack of liquid cesium on these alloys and TD-nickel continue with the utilization of cesium containing carbon and oxygen additions. Author

**N64-14358** IIT Research Inst., Chicago, Ill.

**FRACTURE OF METALS Interim Report, 22 Sep.–22 Dec. 1963**

W. Rostoker 13 Jan. 1964 17 p refs
(Contract DA-11-ORD-022-3108)
(IITRI-B183-15; AD-427068)

It is shown that the delayed failure of Be-copper wetted with Hg is accelerated at temperatures above room ambient. Conversely, delayed failure is retarded by simple heating in the unstressed condition to temperatures above 80° C before loading. Cumulative weakening can be erased by these thermal treatments. A mechanism for delayed failure is described in terms of grain boundary penetration by Hg to critical depths defined by the Griffith criterion for fast failure. The rate of penetration is moderated by temperature, stress level, and predisposition of infused Hg. Author

**N64-14389** Argonne National Lab., Ill. Metallurgy Div.

**NONDESTRUCTIVE TESTS OF COMPONENTS OF EBR-I, CORE IV**

R. H. Selner, C. J. Renken, R. B. Perry, and K. Balaramamoorthy (Atomic Energy Estab., Bombay) Oct. 1963 33 p refs
(Contract W-31-109-eng-38)
(ANL-6632)

The details and results of the following tests are discussed: (1) ultrasonic tests of Zircaloy-2 and zirconium rod stock for rod tip, fuel connector, and filler plug components; (2) ultrasonic tests of zirconium rod stock used in the fabrication of part of the spacer-rib wire; (3) eddy-current tests of Zircaloy-2 core and blanket jacket tubing; (4) eddy-current tests of Zircaloy-2 instrument tubing; (5) eddy-current tests of zirconium spacer-rib wire; (6) eddy-current tests of stainless-steel tubing used in components for the breeding gain experiments; and (7) eddy-current tests of assembled blanket elements for the quality of the NaK bond. P.V.E.

**N64-14420** General Electric Co., Cincinnati, Ohio
**HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 31, Part A [15 Oct.-15 Dec. 1963]**
24 Jan. 1964 37 p refs
(Contract AT(40-1)-2847)
(GEMP-31A) OTS: $0.75

Stress-rupture and creep characteristics of rhenium were measured at 2,600° C in hydrogen and argon. Additional testing of molybdenum at 2,200° C in hydrogen and argon was also conducted. Creep-rupture testing of molybdenum specimens in the temperature region of 870° to 1,100° C was initiated. The irradiation of these specimens to a fast neutron dosage of about $7 \times 10^{18}$ nvt ($E_n \geq 1$ Mev) does not reveal any significant changes in the creep properties. Additional heat treatment of the vendor recrystallized material of control specimens shows a consistent lowering of rupture life and a corresponding increase in the creep rate. Isochronal annealing of irradiated molybdenum resistivity specimens shows recovery peaks at 0.15 and 0.31 $T_m$, consistent with data reported by others for bcc metals. During the course of isochronal annealing of unirradiated warm-worked molybdenum, a peak was observed at about 0.36 $T_m$, which is below the normal recrystallization temperature but in the region of the stress relieving temperature. Hot-hardness measurements were initiated on unirradiated tungsten single crystals. Author

**N64-14425** General Electric Co., San Jose, Calif. Vallecitos Atomic Lab.
**PROCEEDINGS OF THE USAEC SYMPOSIUM ON ZIRCONIUM ALLOY DEVELOPMENT – CASTLEWOOD, PLEASANTON, CALIFORNIA, NOVEMBER 12-14, 1962. VOLUME I**
H. H. Klepfer comp. AEC Div. of Tech. Inform., 30 Nov. 1962 404 p refs
(Contract AT(04-3)-189)
(GEAP-4089, Vol. 1) OTS: $7.50 (Vol.I & II)

CONTENTS:

1. THE DEVELOPMENT OF THE ZIRCALOYS S. Kass (Westinghouse Elec. Corp.) p 1.0–1.44

2. THE DEVELOPMENT OF ZIRCONIUM ALLOYS FOR PRESSURE TUBES IN WATER-COOLED POWER REACTORS W. R. Thomas (AEC of Canada) p 2.0–2.12 refs

3. AN INVESTIGATION OF ZIRCONIUM ALLOYS FOR RESISTANCE TO CARBON DIOXIDE CORROSION W. A. Maxwell (Gen. Nuclear Eng. Corp.) p 3.0–3.50 refs

4. DEVELOPMENT OF Zr-Nb-Sn ALLOYS FOR REACTOR APPLICATIONS H. Richter (Metallgesellschaft AG, Frankfurt) and J. C. Tverberg (GE) p 4.0–4.58 refs

5. RESEARCH ON ALPHA-ACTIVE EUTECTOID ZIRCONIUM ALLOYS R. P. Syre (Pechiney) p 5.0–5.12 refs

6. DEVELOPMENT OF IMPROVED ZIRCONIUM ALLOYS FOR USE IN SUPERHEATED WATER AND STEAM D. Weinstein and F. C. Holtz (IIT Res. Inst.) p 6.0–6.34 refs

7. CORROSION RESISTANCE OF IMPROVED ZIRCONIUM ALLOYS IN HIGH TEMPERATURE STEAM U. Rosler (Siemens-Schuckertwerke AG, Erlangen) p 7.0–7.32 refs

8. ZIRCONIUM ALLOY DESIGN FOR STEAM SERVICE H. H. Klepfer (GE) p 8.0–8.24 refs

9. A METALLOGRAPHIC DETERMINATION OF THE ZIRCONIUM-NIOBIUM DIAGRAM C. E. Lundin and R. H. Cox (Denver U.) p 9.0–9.36 refs

10. TRANSFORMATIONS IN ZIRCONIUM-NIOBIUM ALLOYS R. F. Hehemann (Case Inst. of Tech.) p 10.0–10.50 refs

11. THE EFFECTS OF HEAT TREATMENT ON THE MECHANICAL PROPERTIES OF ZIRCONIUM-2 1/2 w/o NIOBIUM ALLOY J. Winton and R. A. Murgatroyd (UKAEA, Culcheth) p 11.0–11.32 refs

**N64-14427** Brookhaven National Lab., Upton, N.Y.
**THE INVESTIGATION OF CONTAINER MATERIALS FOR Bi AND Pb ALLOYS. PART 1. THERMAL CONVECTION LOOPS**
A. J. Romano, C. J. Klamut, and D. H. Gurinsky Jul. 1963 29 p refs
(Supported by AEC)
(BNL-811(T-313)) OTS: $0.75

Materials for containing liquid Bi and Pb alloys have been tested in the form of thermal convection loops operating at temperatures up to 650° C, both with and without inhibitors in the liquid metal. Zr was found to be the most effective inhibitor in retarding the corrosion of low alloy steels. Carbon steel loops were operated at a temperature differential of 150° C (550° to 400°) for > 10,000 hr with little corrosion detected. Liquid Pb and Pb-Bi eutectic were found less corrosive than Bi and U-Bi. Author

**N64-14456** Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.
**TEAR RESISTANCE OF ALUMINUM ALLOY SHEET AS EVALUATED BY KAHN-TYPE TEAR TESTS**
J. G. Kaufman 28 Nov. 1962 35 p refs
(Rept. 9-62-42)

The results of tear tests of 223 lots of 0.063-in. aluminum alloy sheet representing 80 combinations of alloy and temper have been summarized, and relative ratings of the tear resistance of the alloys and tempers have been developed. Of the alloys tested, the aluminum–magnesium alloys in the annealed temper have the highest tear resistance. Of the heat-treated alloys in the most frequently used commercial tempers, 2024-T3 and 2024-T4, 2219-T62, 6061-T6, and 7075-T73 have the higher tear resistances, while 2024-T86, 2020-T6, and 7178-T6 have the lower tear resistances. Author

**N64-14503** Ladish Co., Cudahy, Wis.
**DEVELOPMENT AND STATISTICAL ANALYSIS: EVALUATION OF MELTING AND TRANSVERSE PROPERTIES OF HIGH-STRENGTH (H-11 TYPE) STEEL Interim Engineering Report No. 5, Jun. 6, 1963-Dec. 6, 1963**
Joseph C. Truszynski and Jack A. Yoblin Jan. 1964 37 p
(Contract AF 33(600)-38767)
(ASD-TR-7-678(V); AD-427689)

Four heats of material processed by vacuum induction melting followed by vacuum arc remelting have been ordered to a specification that requires an average transverse ductility of 12% reduction of area at the 300 to 330 ksi ultimate tensile strength level. An approximately 3,500-pound billet exhibited essentially equal longitudinal and transverse ductility in tensile specimens heat treated to develop a 300 ksi ultimate strength level. Other duplex melt process variations evidenced pronounced anisotropy in comparable 10-inch RCS hot-pressed billets. Author

**N64-14576** Battelle Memorial Inst., Columbus, Ohio
**RE-ENTRY BURNUP ENHANCEMENT OF HYDRIDED ZIRCONIUM URANIUM ALLOY FUEL**
E. L. Foster, Jr. *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 295–327 refs (See N64-14551 06-01) OTS: $4.50

An investigation was undertaken in order to determine the feasibility of changing the properties of the ZrH–uranium fuel by use of certain additives in such a way that the atmospheric burnup upon reentry from orbit would be enhanced. The effects of additions to the fuel, particularly those that could produce smaller droplet size during its reentry melting, were studied by both analytical and experimental methods. It was possible to change the ablation characteristics of hydride fuel. The most significant changes brought about by alloying additions made directly to the melt appeared to be a reduction in ablation tendency. R.T.K.

**N64-14617** General Dynamics/Ft. Worth, Tex.
**STRESS CORROSION CRACKING OF HIGH STRENGTH NICKEL ALLOY STEELS FOR AIRCRAFT APPLICATIONS**
John F. Hildebrand 24 Jun. 1963 47 p refs
(Contract AF 33(657)-11214)
(FZM-2951; AD-428626) OTS: $4.60

Forged parts and billets of AISI 4340, H11 tool steel, and 9% and 18% nickel alloy steels were evaluated for susceptibility to stress corrosion cracking (SCC) by an alternate immersion test. The alloys were prepared by the consumable electrode–vacuum melt practice and were heat treated as test specimens to strengths in the range from 263,000 to 290,000 psi. Polished specimens were alternately immersed in a 5% NaCl solution while sustaining a load equivalent to 75% of the ultimate strength. An H11 tool steel billet exhibited good resistance to SCC in the transverse direction. The 9% nickel alloy steel was more resistant to SCC than the 18% nickel alloy in either salt or distilled water. Both alloys were less susceptible than the AISI 4340 and were at least equivalent to the H11 tool steel. Author

**N64-14622** Honeywell Research Center, Hopkins, Minn.
**THE MOBILITIES OF CESIUM IONS IN CESIUM Interim Technical Report**
L. M. Chanin and R. D. Steen 24 Sep. 1963 19 p refs
(Contract DA-31-124-ARD-(D)-11)
(AD-423289) OTS: $1.60

Measurements have been made of the mobilities of cesium ions using a pulsed-discharge technique. In the present studies two ionic species were observed; however, over the entire $E/p_0$ and $P_0$ range investigated, the "fast" ion type was dominant. The present values are compared with the available theoretical values and also with previous experimental results. From the comparison the dominant ion is tentatively identified as being $Cs_2^+$; the less frequently observed ion is believed to be $Cs^+$. The normalized mobility values corresponding to a gas density of $2.69 \times 10^{19}$ atoms/cc for $Cs^+$ and $Cs_2^+$ are 0.075 and 0.21 $cm^2/V$ sec, respectively, over the temperature range of approximately 579° to 679° K. Author

**N64-14639** Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
**PILOT PRODUCTION AND EVALUATION OF TANTALUM ALLOY SHEET Sixth Quarterly Report, 15 Aug.–15 Nov. 1963**
R. L. Ammon, J. L. Godshall, and R. T. Begley 15 Jan. 1964 35 p refs
(Contract N600(19)59762)
(WANL-PR-M-007; AD-428281)

The evaluation of T-222 (Ta-9.6W-2.4Hf-0.01C) sheet was continued. A second 3-in.-diam. ingot of T-222 was melted and processed to sheet to provide additional material for evaluation. Tensile properties of sheet produced from a single a.c. arc-melted ingot were comparable at 2400° F to properties of sheet produced from a double a.c. melted ingot. At 3000° F the single a.c. melted material showed abnormal scatter in the data, whereas double arc-melted material showed consistent properties. Several smaller heats of experimental alloys were also melted and processed to sheet. Phase identification studies of T-222 were also continued with emphasis on the development of a reliable technique for bulk extraction of precipitated phases from Ta-W-Hf-C alloys. Author

**N64-14653** Illinois U., Urbana Fracture Research Lab.
**CYCLIC STRAIN ACCUMULATION UNDER COMPLEX MULTIAXIAL LOADING Technical Documentary Report, Apr. 1961–Jun. 1963**
G. J. Moyar and G. M. Sinclair Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1963 45 p refs
(Contract AF 33(616)-8177)
(RTD-TDR-63-4120; AD-427919)

When a tubular specimen of copper is subjected to a small steady tension and alternating torsion at room temperature, large axial-strain increments accumulate on a cyclic basis. At relatively low values of axial stress, a steady-state cyclic-strain accumulation is observed to develop. The strains and cyclic-strain rates which are observed are many orders of magnitude greater than corresponding values obtained under conditions of standard static-creep tests performed at the same peak effective stress. They are also many times larger than those obtained due to simple repetition of the effective stress in more conventional dynamic-creep tests. The experiments were designed to produce an extreme case of cyclic creep wherein time and temperature dependence are minimized. The analysis of results includes a comparison with plasticity theory predictions as well as a parametric description of minimum cyclic creep rate. Author

**N64-14776** Solar, San Diego, Calif.
**DEVELOPMENT OF PROTECTIVE COATING FOR TANTALUM BASE ALLOYS Quarterly Progress Report 2, 1 Sep.–31 Nov. 1963**
B. Ohnysty and A. R. Stetson 12 Dec. 1963 66 p refs
(Contract AF 33(657)-11259)
(RDR-1360-2; AD-429028) OTS: $6.60

Pack cementation studies were conducted on 90Ta-10W alloy with pure silicon and silicon plus tungsten, molybdenum, chromium, vanadium, boron, manganese, and aluminum. Oxidation test results at 2700° F indicated that the vanadium–chromium, titanium–chromium, and titanium-modified silicide provided the longest oxidation lives, i.e., 3 to 5 hours. Measurement of the thermal expansivities and oxygen diffusion rates through high hafnia oxide compositions continued. Modification of hafnia with zirconia and/or yttria appeared to be capable of producing a close expansion match with 90Ta-10W alloy. Modification of the electrical conductivity apparatus for determination of oxygen diffusivity continued. Measurement of oxygen diffusion in hafnia was made by the weight change method. Author

**N64-14784** Lockheed Propulsion Co., Redlands, Calif.
**DESIGN, FABRICATION AND HYDROTESTING OF A 120-INCH DIAMETER PRESSURE VESSEL USING 18 PERCENT NICKEL MARAGING STEEL Status Report No. 8, 10 Oct.–12 Nov. 1963**

L. Colbert 25 Nov. 1963 72 p refs
(Contract AF 04(611)-8525)
(LPC-609-P-8; AD-429031) OTS: $7.60

This report describes the detailed metallurgical analysis performed to determine the cause of closure-plate fracture during hydroburst testing of the Lockheed–Excelco 120-in. diam., 18-percent-nickel maraging steel prototype booster case. The metallographic and mechanical strength data lead to the belief that delamination of the plate welded to the ring forging is largely responsible for the failure of the closure plate at around half the designed membrane stress. The delamination seems to be triggered by the yielding of the retained austenite and cracking of carbides and nitrides in the banded areas of the plate, leading to the formation of a chain of small cracks followed by interplanar separation in the plate. Another possible cause of closure plate separation is linked with the failure of a large portion of the shear lip in the ring forging. Author

**N64-14790** Westinghouse Electric Corp., Blairsville, Pa. Materials Manufacturing Div.
**HIGH ENERGY RATE EXTRUSION PROGRAM Interim Technical Progress Report No. 11, 1 Jun.–30 Sep. 1963**
J. M. Rippel Wright-Patterson AFB, Ohio, Mfg. Tech. Lab., Oct. 1963 43 p
(Contract AF 33(600)-41948)
(ASD-TR-7-882(XI); AD-422115) OTS: $4.60

Thin Tee sections of TZM, molybdenum-base alloy, and B-66, columbium-base alloy, were extruded by the high-velocity extrusion process. Nominal dimensions of the Tee section were 2 by 1 by 0.050 to 0.070 in. Surface finish was generally better than 100 RMS, and radii were good. Maximum lengths were 7 feet of the TZM alloy and 4 feet of the B-66 alloy. These lengths were near the maximum obtainable because of the stiffness of the alloys and the power limitations of the machine. The effect of temperature and reduction ratio on the extrusion pressure was investigated. The B-66 alloy has a tendency to become hot short at temperatures over 3200° F and was, therefore, limited to lower extrusion temperature and shorter lengths. The TZM alloy extruded at 3700° F to 3900° F satisfactorily, and the lower temperatures produced the best surfaces. Ceramic coated $ZrO_2$ dies were used and did not show any wear when extruding B-66 alloy. They did appear to open up or wear slightly when extruding TZM. Author

**N64-14793** Pfaudler Co., Rochester, N.Y.
**INVESTIGATION OF PRACTICAL TECHNIQUES FOR COATING REFRACTORY METALS Quarterly Progress Report No. 2, 1 Aug.–31 Oct. 1963**
J. Zupan, E. G. Pike, and J. B. Whitney 15 Nov. 1963 44 p
(Contract AF 33(657)-8920, Suppl. 1)
(PF-63-10; AD-428575)

Fused salt bath experiments were carried out in apparatus designed for deposition of titanium and chromium coatings by a continuous process. In general, average weight gains of samples were lower than for those coated by a batch process with a similar bath composition. Factors causing this difference are being explored, and modifications will be made to optimize the continuous process. The operating characteristics of the 8-in.-diam. fluidized bed have been determined, and the major portion of the equipment has been calibrated. Electrokinetic and rheological studies of particles are being continued to obtain basic data for the design of slurry process systems. Current efforts have been directed toward the stabilization of water-based aluminum slurries and the study of the effects of surfactants on suspension properties. Author

**N64-14800** Ghent U. (Belgium)
**LOW-STRESS BRITTLE FRACTURE IN MILD STEEL Special Report**
R. Dechaene, W. Soete, and A. Vinckier 30 Aug. 1963 23 p refs
(SSC-158; PB 181547) OTS: $0.75

Low-stress brittle fracture in mild steel was investigated. Results include the following: (1) Plastic deformation in cracked plates occurs mainly by shear in narrow regions extending from the crack tip to the free edge, under about 45° with the direction of the applied load. Near the crack tip, where two such regions converge, extremely high strains are set up, even for small overall extensions. For the same average stress, the strains and the extension in the specimen with the shorter cracks are higher. (2) The presence of cracks, notches, or flaws in a structure is perhaps the most important reason for the lack of overall elongation at fracture. This reduction of deformation is enhanced by low temperatures and larger width of the specimen. (3) The presence of intergranular carbide particles, precipitated during the high temperature deformation, is, in all probability, directly responsible for the intergranular weakening, and thus results in room-temperature embrittlement of the steel. (4) Prestraining at a critical temperature obtained by local heating may have a deleterious influence on the ductile behavior of steel; moreover, welding may be directly responsible for the embrittlement. I.v.L.

**N64-14931** Bureau of Mines, Albany, Ore. Metallurgy Research Center
**A SYSTEM FOR ELECTRON-BEAM MELTING**
Floyd W. Wood, J. L. Hoffman, W. E. Anable, and R. A. Beall 1964 39 p refs
(Contract AT(11-1)-599)
(BM-RI-6341)

For melting and purifying reactive and refractory metals, two electron-beam furnaces have been constructed and operated on the principle of high-powered vacuum diodes. The furnaces have been used to melt either button specimens weighing several hundred grams or, by feeding material as a consumable electrode, small ingots weighing several kilograms. Hafnium is among the metals that can be purified. For example, hafnium starting material with Rhn 948 was softened to Rhn 708 after 2 hours of melting under a 25-kw electron beam, and impurity levels were reduced as follows: oxygen, from 700 to 350 ppm; nitrogen, from 71 to 20 ppm; hydrogen, from 6 to 1 ppm; aluminum, from 75 to < 20 ppm; chromium, from 80 to < 10 ppm; iron, from 100 to 40 ppm; and silicon, from 40 to < 20 ppm. Author

**N64-14964** Battelle Memorial Inst., Columbus, Ohio
**BERYLLIUM. REVIEW OF RECENT DEVELOPMENTS**
Webster Hodge 7 Feb. 1964 4 p refs
(AD-429091)

Recent developments pertaining to beryllium include: (1) Beryllium bars, obtained by fusion under ultravacuum by electron bombardment of foils of electrolytic beryllium, were further purified by floating-zone fusion under argon. After the third pass, the bars could easily be bent by hand at room temperature. (2) Beryllium was successfully joined with a magnetic-force welder. (3) Electron-beam welding of beryllium using moderately high-power densities and low welding speeds has resulted in welds that were sound, crack-free, and exhibited good joint strengths. (4) Tolerances to 10 millionths of an inch have been held by honing and lapping. (5) The addition of iron to zone-refined crystals (critical resolved shear stress (CRSS) for basal slip = 300 psi) at the 1500-ppm level resulted in an increase in CRSS for basal slip to 2000 psi.

(6) The maintenance of a suitable ratio between iron and aluminum in beryllium can avoid a liquid phase in the grain boundaries that leads to general decohesion. (7) The fcc phase found in aged commercial beryllium appears to be $AlMBe_4$, where M is a transition element. I.v.L.

# 19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

**N64-14171** Little (Arthur D.), Inc., Cambridge, Mass.
**RESEARCH ON THERMODYNAMICS OF THE Al-B-O AND Be-B-O SYSTEMS Quarterly Report No. 5, 1 Jun.–31 Aug. 1963**
Paul E. Blackburn 1963 12 p refs
(ARPA Order 315-62)
(AD-428106)

Pressure composition measurements have been made on the $BeO$-$B_2O_3$ system at two temperatures. Using the $MgO$-$B_2O_3$ system as a model and literature evidence for $3BeO$-$B_2O_3$, a phase diagram has been constructed for the Be-B-O system. The measurements and constitutional diagram agree in many respects. Author

**N64-14189** Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
**HIGH POLYMERIC MATERIALS**
L. W. Frost *In* Natl. Acad. of Sci.-Natl. Res. Council. Dielectrics. Dig. of Lit., Vol. 26, 1962 1963 p 229–265 refs (See N64-14182 06-01)

An annotated bibliography covering the following topics is presented: general studies; mechanical properties and testing; electrical properties and testing; thermal stability and high-temperature properties; casting; potting; encapsulation; wire insulation and varnishes; special applications; fluidized bed coating; irradiation; adhesives and tapes; reinforced plastics; foams; elastomers; block and graft polymers; acrylics; polyamides and polyimides; polycarbonates; cellulose and derivatives; epoxies; polyester; polyethers; fluorinated polymers; hydrocarbon polymers; phenolics and melamines; silicones; polyurethanes; vinyl polymers; phenolics and melamines; silicones; polyurethanes; vinyl polymers; and other polymers. R.T.K.

**N64-14190** Bell Telephone Labs. Inc., Murray Hill, N.J.
**INSULATING FILMS AND FIBROUS MATERIALS**
Donald D. Kasarda *In* Natl. Acad. of Sci.-Natl. Res. Council. Dielectrics. Dig. of Lit., Vol. 26, 1962 1963 p 267–283 refs (See N64-14182 06-01)

The following subjects are included in the annotated bibliography: fibers and fibrous materials, polymer films, capacitors and other applications, and review articles. R.T.K.

**N64-14191** Edison (Thomas A.) Industries, West Orange, N.J.
**INSULATING LIQUIDS AND APPLICATION**
M. P. Strier *In* Natl. Acad. of Sci. Natl. Res. Council Dielectrics. Dig. of Lit., Vol. 26, 1962 1963 p 285–302 refs (See N64-14182 06-01)

The following subjects are covered in this annotated bibliography: dielectric strength and breakdown; dielectric constant and loss; theoretical aspects of dielectric properties; cable, capacitor, and transformer applications; and insulating oils (general characteristics). R.T.K.

**N64-14192** General Electric Co., Schenectady, N.Y. Research Lab.
**INORGANIC INSULATION**
R. C. Anderson *In* Natl. Acad. of Sci.-Natl. Res. Council. Dielectrics. Dig. of Lit., Vol. 26, 1962 1963 p 303–315 refs (See N64-14182 06-01)

An annotated bibliography is presented that concerns single-phase materials, vitrified silicates, glass, and mica. R.T.K.

**N64-14243** Iowa State U. of Science and Tech., Ames
**CARBIDES**
William A. Frad (Mo. School of Mines) 1 Sep. 1963 94 p refs (Contract W-7405-eng-82)
(IS-722) OTS: $2.00

This report is the result of a general survey covering the literature published on carbides. Nonmetal carbides such as $C_2N_2$, Co. $CS_2$, $CCl_4$, etc., are not included in this report. The material is organized on the basis of the families of elements in the periodic chart of the atoms. Data concerning formulas, composition ranges, preparation, and crystal structure are presented. Temperature ranges of structure stability for carbides having more than one crystal form are included in a number of cases. Key references are cited. Author

**N64-14271*** Advanced Metals Research Corp., Somerville, Mass.
**PROPERTIES OF NON-STOICHIOMETRIC METALLIC CARBIDES Quarterly Progress Report No. 3**
J. T. Norton and R. K. Lewis 12 Dec. 1963 9 p refs
(NASA Contract NASw-663)
(NASA-CR-55272) OTS: $1.10 ph, $0.80 mf

Activities are reported in the following areas: (1) preparation of pure, sintered carbide specimens having sufficient length to make thermal expansion and thermoelectric measurements; (2) attachment of thermocouple leads to carbide specimens; (3) construction of a dialatometer suitable for making thermal expansion measurements on carbide specimens; and (4) obtaining thermal expansion measurements on TiC from 0° to 1,000° C. R.T.K.

**N64-14290*** National Bureau of Standards, Boulder, Colo.
**INTERIM THERMODYNAMIC PROPERTIES FOR GASEOUS AND LIQUID OXYGEN AT TEMPERATURES FROM 55 TO 300° K AND PRESSURES TO 300 ATM**
R. B. Stewart, J. G. Hust, and R. D. Mc Carty 1 Oct. 1963 105 p refs
(NASA Order R-45)
(NASA CR-55332; NBS-7922) OTS: $9.10 ph, $3.35 mf

Interim values of internal energy, entropy, enthalpy, and density of oxygen are tabulated as functions of pressure and temperature from 55° to 300° K and 0.1 to 300 atm. These values have been calculated using a modified BWR equation of state fitted to experimental liquid data and calculated gaseous data. The gaseous data were calculated using the theory of corresponding states with nitrogen as the model. Author

**N64-14308** Little (Arthur D.) Inc., Cambridge, Mass.
**RADIATION ACTIVATION OF PARA-ORTHO HYDROGEN CATALYSTS**

Amos J. Leffler Wright-Patterson AFB, Ohio. AF Aero-Propulsion Lab., Dec. 1963 56 p refs
(Contract AF 33(657)-8878)
(RTD-TDR-63-4106; AD-425799)

An investigation was carried out to determine whether improved catalysts for the para–ortho hydrogen conversion could be obtained by radiation. In the course of this work a series of catalysts were found that were as high as ten times more effective than a standard hydrated iron oxide catalyst at −78° C. Included in this series of catalysts were two that were radiation activated. As a result of this work an improved understanding of the catalytic mechanism was obtained. Author

**N64-14312** Sperry Microwave Electronics Co., Clearwater, Fla.
**DEVELOPMENT OF ADVANCED MICROWAVE COMPONENTS AND TECHNIQUES – PLANAR HEXAGONAL FERRITES AND DEVICES Technical Documentary Report [Jun. 28-Sep. 28, 1963]**
Griffiss AFB, N.Y., RADC, Dec. 1963 40 p refs
(Contract AF 30(602)-2757)
(RADC-TDR-63-508; AD-427822)

Studies have been made of the preparation and properties of Y compounds with compositions near $Zn_{2.0}Y$, $Ni_{1.0}Zn_{1.0}Y$, $Cu_{0.5}Zn_{1.5}Y$, and $Ni_{0.3}Cu_{0.7}Zn_{1.0}Y$. X-ray diffraction patterns taken on Y compounds with aluminum substituted for iron strongly indicate the formation of a second phase, rather than a replacement of $Fe^{+3}$ by $Al^{+3}$ in the Y structure. While densities of greater than 95 percent of the theoretical value and alignment indices of 0.98 and above have been obtained, linewidths remain somewhat high, approximately 400 oe. Because of the extremely good alignment of planar materials achieved, experiments have been started to orient cubic materials. Initial experiments with polycrystalline yttrium iron garnet have been very encouraging, and linewidths of 18 to 19 oe have been obtained. Initial investigation of the application of planar ferrites to isolator structures are reported. Because of the small sizes and shapes of planar ferrites now available, only low isolation values are found, but isolation ratios of as high as 60 are obtained. Author

**N64-14313** Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.
**LITERATURE SURVEY ON THERMAL DEGRADATION, THERMAL OXIDATION, AND THERMAL ANALYSIS OF HIGH POLYMERS**
David W. Levi Jun. 1963 156 p refs
(Plastec Note 7; AD-276141) OTS: $2.75

A bibliography is given of references resulting from a literature survey on thermal degradation, thermal oxidation, and thermal analysis of high polymers. Typical of the materials included are: polystyrene, polyethylene, polybenzyls, polyphenyls, polyxylenes, hydrocarbon polymers, halogen substituted polymers, polymers containing acid and ester groups, synthetic polymers, and some inorganic and semiorganic systems. Items are grouped under general and material headings, and a subject index and an author index are provided. Author

**N64-14345** Aerospace Corp., El Segundo, Calif. Materials Science Lab.
**STRUCTURAL CHANGES IN PYROLYTIC GRAPHITE AT ELEVATED TEMPERATURES**
J. H. Richardson and E. H. Zehms 1 Dec. 1963 30 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-340; TDR-269(4240-10)-3; AD-427346) OTS: $2.60

Gross and unit cell dimensional changes of pyrolytic graphite have been measured as a function of heat-treatment times between 15 sec and 10 min at temperatures from 2,600° to 3,000° C. These changes have also been measured for 4-hr heat treatments in the same temperature range. For example, growth along the basal planes and contraction in the $C_o$ direction are 0.63 percent and 1.1 percent, respectively, for a 90-sec heat treatment at 3,000° C. No incubation period for these changes has been noted above 2,600° C. The effects of these changes in rocket nozzle and reentry configurations are discussed. Author

**N64-14402** Los Alamos Scientific Lab., N. Mex.
**THE VAPOR PRESSURE OF INDIUM**
C. C. Herrick 29 Jan. 1964 33 p refs
(Contract W-7405-eng 36)
(LA-2995) OTS: $0.75

Measurements were made of the vapor pressure of indium as a function of temperature between 1143° and 1422° K employing the torque-effusion technique. The vapor pressure (in atmospheres) of liquid indium is given by the equation $\log P = 5.782 \times 10^3/T - 25.29$ in the experimental range. Extrapolation yields a calculated normal boiling point of 2329° K and a heat of vaporization at 298° K of 58.09 kcal by the third-law method and 58.39 kcal by the second-law method. Author

**N64-14404** Georgia Inst. of Tech., Atlanta Engineering Experiment Station
**CALCULATION OF THE VAPOR PRESSURE AND HEATS OF VAPORIZATION AND SUBLIMATION OF LIQUIDS AND SOLIDS, ESPECIALLY BELOW ONE ATMOSPHERE. IV. NITROGEN AND FLUORINE Technical Report No. 1**
W. T. Ziegler and J. C. Mullins 15 Apr. 1963 71 p
(Contract CST-7404)
(MR-15)

The vapor pressure and heats of vaporization and sublimation of nitrogen and fluorine have been computed at one degree intervals from the normal boiling point to 10° K and 14° K, respectively, using available thermodynamic data. The computed results have been compared with the published experimental data. Author

**N64-14474** Mass. U., Amherst Polymer Research Inst.
**THE SCATTERING OF LIGHT FROM THIN POLYMER FILMS. V THEORY FOR SCATTERING FROM ORIENTED POLYMERS+**
R. S. Stein and T. Hotta 8 Aug. 1963 21 p refs
(Contract Nonr 3357(01) and AEC support)
(ONR-TR-57; AD-428793) OTS: $2.60

The scattering results principally from correlation in orientation of crystals over distances comparable with the wavelength of visible light. For unoriented polymers, all crystal orientations are equally likely, and the orientation correlation possesses spherical symmetry. This results in a scattering pattern that is independent of the angle $\Omega$ about the incident ray and also independent of the tilt angle of the polymeric film. For uniaxial orientation, the scattering pattern becomes dependent upon the angle $\Omega$ but is still independent of $\Phi$. The change in scattering occurring upon orientation is a consequence of: (1) the orientation of the principal polarizability direction; and (2) the deviation of the orientation correlation function possesses cylindrical symmetry. The dependence of the scattered intensity upon $\Omega$ is dependent upon the scattering angle $\Theta$. Since larger structures scatter predominantly at smaller angles, a greater $\Omega$ dependency would be expected at smaller $\Theta$s if the orientation of larger structures is greater than

that of those smaller. For biaxial orientation, scattering depends upon $\Theta$, $\Omega$, and $\phi$. Both the orientation distribution of the principal polarizability direction and the orientation function distribution are different in the three principal directions. R.T.K.

**N64-14476** Thiokol Chemical Corp., Trenton, N.J.
**NITROSO RUBBER RESEARCH, DEVELOPMENT AND PRODUCTION Report Period 1 Jun.-31 Aug. 1963**
Marvin M. Fein [1963] 37 p refs
(Contract DA-19-129-AMC-69(X)0.1. 9044)
(RD-343-Q2; RMD-8576-Q2; AD-428791)

A satisfactory scaleup process for the production of trifluoronitrosomethane has been developed. The process involves the decarboxylation of trifluoroacetyl nitrite in refluxing FC-43, $(C_4F_9)_3N$. Copolymerization of nitroso monomer with tetrafluoroethylene has yielded gums of 300,000 to 500,000 average molecular weight. Author

**N64-14516** National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
**THE THERMODYNAMIC PROPERTIES OF NITROGEN FROM 114 to 540°R BETWEEN 1.0 AND 3000 PSIA. SUPPLEMENT A (BRITISH UNITS)**
Thomas R. Strobridge Feb. 1963 92 p refs
(NBS-TN-129-A)

The internal energy, enthalpy, entropy, and specific volume of molecular nitrogen are derived and tabulated as functions of temperature and pressure. In addition to a mathematical model for the pressure–volume–temperature surface, accurate functions are given for the representation of the vapor pressure, density of saturated liquid, specific heat of saturated liquid, and the specific heat at zero pressure. Author

**N64-14626** United States Rubber Co., Wayne, N.J.
**PHOSPHONITRILIC POLYMERS STABLE AT HIGH TEMPERATURES Technical Report No. 3, 1 Jun. 1963-31 Aug. 1963**
Harold K. Garner and Gerald J. Klender 11 Nov. 1963 55 p refs
(Contract NObs-88232)
(AD-424502) OTS: $5.60

This project was undertaken to develop new thermoplastic and thermosetting resins from phosphonitrilic chloride trimer for high temperature electrical applications. Derivatives of phosphonitrilic chloride trimer containing phenoxy, ethoxy, and chloro groups in various proportions have been found to polymerize to hard, clear resins by the elimination of ethyl chloride and the formation of P-O-P linkages. Further work on monomers for this polymerization is also described. Author

**N64-14631** Puget Sound Naval Shipyard, Bremerton, Wash. Quality Assurance Div.
**LIGHTWEIGHT REINFORCED PLASTIC FACED SANDWICH CONSTRUCTION**
M. E. Phelps Jun. 1963 29 p
(PSNS-MAT-LABS-P-565; AD-407252)

The values of impact and flexure properties of sandwich panels with polyurethane foam and balsa wood cores with laminated glass–resin faces are shown. Author

**N64-14632** New England Materials Lab., Inc., Medford, Mass. Research Div.
**DISPERSION STRENGTHENED NICKEL-BASE ALLOYS Progress Report No. 4, 1 Sep.-31 Oct. 1963**
A. S. Bufferd, R. C. Nelson, and N. J. Grant 18 Dec. 1963 8 p
(Contract N600(19)59891)
(AD-426138)

The swaged cone of extruded Nichrome-thoria alloys prepared by the thermal decomposition of thorium nitrate onto alloy powder indicated decreased capacity for cold working with increased oxide content and increasing hardness levels with increasing amounts of thoria and cold working. The cold swaging of these dispersion-strengthened Nichrome alloys was dependent on the presence of a mild steel jacket on the alloy rod as a result of the canned extrusion practice. Efforts to cold swage the alloy materials without this jacket were unsuccessful. Author

**N64-14676** General Technologies Corp., Alexandria, Va.
**A STUDY OF HIGH MODULUS, HIGH STRENGTH FILAMENT MATERIALS BY DEPOSITION TECHNIQUES First Bi-Monthly Progress Report, 1 Nov.-31 Dec. 1963**
L. G. Davies and J. C. Withers 15 Jan. 1964 14 p refs
(Contract NOw 64-0176-C)
(AD-427972)

Candidate filament materials were selected from a list of high modulus-to-density ratio materials. The list was compiled from presently available literature. Materials selected to be investigated had a modulus-to-density ratio of greater than $2.50 \times 10^8$in. Of the materials selected, boron, boron carbide, and titanium carbide filaments were deposited by vapor deposition techniques. To assist in the screening of the selected filament materials, a tensile strength tester was designed and built. Author

**N64-14678** Naval Research Lab., Washington, D.C.
**STUDIES ON REDUCING THE SURFACE FRICTION OF ELASTOMERS**
H. C. Nash and E. J. Kohn 1 May 1963 17 p refs
(NRL-5911; AD-405838) OTS: $0.50

Methods for reducing the surface friction of elastomeric vulcanizates have been investigated, and frictional data have been obtained on polytetrafluoroethylene (TFE) coatings sprayed from aqueous dispersions onto elastomeric vulcanizates. The surface frictional characteristics of TFE-coated vulcanizates were essentially independent of the hardness of the vulcanizate, in marked contrast to the behavior of uncoated elastomers. Similarly, the frictional behavior of coated elastomers was virtually independent of the thickness of the elastomer substrate. Author

**N64-14681** Princeton U., N.J. Frick Chemical Lab.
**VISCOELASTIC PROPERTIES OF SOME ALKYL DISULFIDE COPOLYMERS**
W. J. Mac Knight, M. Takahashi, and A. V. Tobolsky Dec. 1963 21 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-67; AD-427849)

Modulus-temperature data, modulus-time data, and glass transition temperatures have been obtained for the following copolymer systems: ethylene disulfide and ethyl ether disulfide; ethylene disulfide and ethyl formal disulfide; and ethylene disulfide and $\alpha$ paraxylene disulfide. Master stress relaxation curves were constructed for poly(ethyl formal disulfide), poly-(paraxylene disulfide), and poly(ethylene tetrasulfide) and show a marked resemblance to those obtained for amorphous hydrocarbon polymers. Author

**N64-14686** Vidya, Inc., Palo Alto, Calif.
**A STUDY OF SOLID-PROPELLANT ROCKET MOTOR EXPOSED MATERIALS BEHAVIOR Second Quarterly Progress Report, 1 Sep.-30 Nov 1963**
Peter A. McCuen, Raymond E. Lundberg, and John W. Schaefer [1963] 149 p refs
(Contract AF 04(611)-9073)
(RTD-TDR-631076; AD-428437)

The work has been directed toward the development of a digital computer program applicable to materials, such as tungsten and graphite, that, in general, do not erode appreciably or that erode with one moving boundary. This has required effort in the areas of convective heat transfer, transient conduction, equilibrium chemistry, reaction kinetics, and mass transport, as applied to the solid-propellant rocket problem; this work is discussed in detail. A plasma-generator rocket simulation-test program has been formulated to complement the theoretical studies, and the test program and some firing results are described. Author

**N64-14734** Rutgers U., University Park, N.J.
**ELASTIC MODULI AND TENSILE STRENGTH OF GLASSES AND OTHER CERAMIC MATERIALS Progress Report No. 3, 1 Jul.-31 Dec. 1963**
John H. Koenig et al [1963] 7 p refs

Apparatus has been constructed for drawing glass fibers continuously at speed up to 2,400 fpm. A special furnace has been built in which the fibers can be conditioned in such a way that their thermal history will always be the same. Other equipment has been built for measuring the modulus of elasticity of the fibers by a sonic method. All of this equipment is now in operation. Author

**N64-14746*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**VARIATION OF SOME PROPERTIES OF TANTALUM CARBIDE WITH CARBON CONTENT**
Gilbert Santoro Repr. from Trans. the AIME Met. Soc., v. 227, Dec. 1963 p 1361-1368 refs
(NASA RP-122)

A number of properties have been investigated in the fcc phase of the Ta-C system. It has been found that a maximum in microhardness, a minimum in tensile strength, a minimum in bend moduli and deflection, a maximum in diamagnetism, and a color transition occur between $TaC_{0.8}$ and $TaC_{0.85}$. It is thought that an electronic structural transition in this composition range is responsible for the color change and for the change in the slope of the susceptibility curve. Author

**N64-14748** Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
**THE EFFECT OF GAMMA RAYS ON POLYMETHYL METHACRYLATE**
N. Kishi and K. Kamata Nov. 1963 9 p refs Transl. into ENGLISH from Oyo Butsuri (Tokyo), v. 30, no. 6, 1961, p 411-416
(TIL/T-5400)

The following results are reported: (1) Stressed and unstressed specimens show no difference in the molecular weight change with irradiation. (2) Mechanical properties deteriorate rapidly with dosage above $3 \times 10^6$ γ and degree of polymerization below 1,500. (3) Glass transition temperature becomes lower with increase in dose. (4) Bubble formation on heating even after more than 2 years' storage of irradiated PMMA is probably partly due to the heating. Author

**N64-14783** Corning Glass Works, N.Y.
**GLASS LASER RESEARCH Annual Technical Report, May 1962-Jun. 1963**
T. C. Mac Avoy, M. L. Charters, R. D. Maurer, W. H. Dumbaugh, and N. F. Borrelli 28 Jun. 1963 135 p refs
(Contract Nonr-3833(00))
(LRC-63-991; AD-429010) OTS: $10.50

A study of the spectral properties of neodymium-doped glasses has been undertaken with objects of (1) determining how the porperties of glass influence the performance of a Nd-doped glass laser, and (2) developing the best possible glasses for high-power applications. The work consists of an extensive study of a wide variety of different glass compositions in parallel with a detailed study of the spectral properties of one glass. The main features of the influence of glass properties on spectral properties are now known. The silicates show the longest lifetimes and most intense fluorescence; the borates show the shortest lifetimes and weakest fluorescence. Since oscillator strengths are about equal for all glasses studied, the borates are apparently quenched. In addition to gross compositional effects, certain impurities, such as iron, copper, and nickel, quench the neodymium fluorescence. One of the more promising glasses has been prepared in the best optical quality available and is currently undergoing intensive study. Author

**N64-14814** Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center
**THERMODYNAMICS OF ORGANIC DERIVATIVES OF THE LIGHTER ELEMENTS Quarterly Technical Summary Report No. 20, 1 Oct.-31 Dec. 1963**
D. R. Douslin, H. L. Finke, W. D. Good, and D. W. Scott [1963] 6 p ref
(ARPA Order 416)
(AD-429092)

Combustion studies of two classified compounds are being pursued, and trial tests are being made of a promising new scheme for burning, accurately, the intractable aluminum and aluminum-boron compounds. Combustion experiments on hexafluorobenzene were completed. Vapor pressures and the heats of vaporization of hexafluorobenzene were completed. Entropy values for hexafluorobenzene, obtained from the low-temperature calorimetry and vapor pressure measurements, indicate that a revision of the Steele and Whiffin vibrational assignment is needed. Author

**N64-14815** Army Chemical Center, Edgewood, Md.
**FOURTEENTH MATERIALS REVIEW, JANUARY 1963-JULY 1963**
Arthur Lyem Dec. 1963 90 p refs
(CRDL-SP-5-3; AD-429071)

Information concerning recent technological advances is presented under five major headings: high polymers, plastic materials, synthetic fibers, miscellaneous organic and inorganic compounds, and metals and alloys. Materials and technological aspects are discussed, and a complete bibliography is given. Author

**N64-14831** College of Aeronautics, Cranfield (Gt. Brit.)
**CHARACTERISTICS OF THE HIGH TEMPERATURE MECHANISM OF CREEP AND RECOVERY IN GRAPHITE Quarterly Technical Status Report No. 1, 1 Aug.-31 Oct. 1963**
Nov. 1963 5 p
(Contract DA-91-591-EUC-2880)
(COA-M-MAT-10; AD-429060)

The experimental material consisted of ground petroleum coke in a pitch binder with 10% ground artificial graphite. The

extruded rods were carbonized at 1,200° C; rods in this form were referred to as "ungraphitized." Part of the batch was subsequently heat treated for one-half hour at 2,500° C, and these were referred to as "graphitized." The trends in the creep behavior were: (1) that the amount of creep strain in a given time increases with temperature for the graphitized material; and (2) that ungraphitized material tested above 2,000° C has a high creep rate when compared to the graphitized material. On recovery from a constant creep strain of approximately 0.010, the temperature and the state of graphitization did not appear to exert large effects. R.T.K.

**N64-14918** Bureau of Mines, Berkeley, Calif. Thermodynamics Lab.
**LOW-TEMPERATURE HEAT CAPACITIES AND ENTROPIES AT 298.15° K OF LEAD MOLYBDATE AND LEAD TUNGSTATE**
William W. Weller and K. K. Kelley 1964 9 p refs
(BM-RI-6357)

Heat capacity measurements of lead molybdate and lead tungstate were conducted over the temperature range from 51° to 298° K. The entropies were found to be $S_{298.15} = 39.7 \pm 0.5$ cal/deg mole for lead molybdate and $S_{298.15} = 40.2 \pm 0.5$ cal/deg mole for lead tungstate. The entropy values were combined with other pertinent data to obtain the entropies of formation of the two compounds from their constituent elements and oxides. Author

# 20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

**N64-14174** Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.
**AN N-DIMENSIONAL SEARCH AND OPTIMIZATION PROCEDURE**
B. L. Beskind 6 Dec. 1963 36 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-324; TDR-269(4550-20)-2; AD-426103) OTS: $3.60

When a mathematical model of a physical system is constructed, it is often seen to contain a set of N time-invariant independent variables, $x^T = (x_1 \ldots x_i \ldots x_N)$. The procedure described enables the finding of a value of $x^T$ such that $f(x) = 0$, where $f(x)$ is a vector M functions defined by the system at discrete points. Once the desired behavior is attained, anf if $N > M$, them the procedure will also optimize the system, when the criterion for this optimization is that $f_0(x)$, called the payoff function, takes on an extreme value. The behavior of the system is approximated by a first order Taylor series in x. The resulting linear equations are solved for that $\Delta x$ which produces a minimum sum-square percentage change in the variables. Once the constraints, $f(x) = 0$, are satisfied, the payoff function is driven to an extremum by demanding successively larger (smaller) values for $f_0(x)$. The procedure is an operational computer program. Some of the more salient features of the program include the ability to handle inequality constraints, bounded variables, search convergence rates, and optimization sequence logic. Author

**N64-14261*** Rensselaer Polytechnic Inst., Troy, N.Y.
**ANALYSIS OF PIECE-WISE LINEAR SYSTEMS BY THE METHOD OF INTEGRAL EQUATIONS**
C. N. Shen and Hubert Wang (Ph.D. Thesis) Repr. of Tech. paper from 1963 Joint Autom. Control Conf., p 369-374 refs
(NASA Grant NsG-14-59)

In automatic control systems, many nonlinearities are actually piecewise linearities or can be approximated as such. Systems of this type are analyzed by the solution of their corresponding integral equations. The method is felt to be particularly advantageous when a digital computer is used. R.T.K.

**N64-14289*** Minneapolis—Honeywell Regulator Co., Minn.
**A CONCISE FORMULATION OF A BOUNDED PHASE COORDINATE CONTROL PROBLEM AS A PROBLEM IN THE CALCULUS OF VARIATIONS**
W. W. Schmaedeke and D. L. Russell 12 Dec. 1963 7 p
(NASA Contract NASw-563)
(NASA CR-55351; MH-MPG-1541-TR10) OTS: $1.10 ph, $0.80 mf

A short calculation is presented that transforms a bounded phase coordinate control problem for a linear time varying system into a problem in the calculus of variations. Author

**N64-14298** Brown (D.) Associates, Inc., Eau Gallie, Fla.
**PHOTOGRAMMETRIC MATHEMATICAL TARGETING RESEARCH**
Arnold H. Lanckton Griffis AFB, N. Y., Inform. Process. Lab., Nov. 1963 51 p refs
(Contract AF 30(602)-3007)
(RADC-TDR-63-476; AD-427759)

The results of an investigation of numerical and electronic computer techniques for solving the large system of normal equations arising from analytical photogrammetric multiple-station aerotriangulation are presented. Four different internal arrangements of the normal equations, three point-iterative and two block-iterative procedures for solving the normal equation system, and compacting of the normal equations are discussed, and results of tests of the various possible combinations of equation arrangements and iterative techniques are presented. Results reveal a particularly attractive solution technique that provides an efficient, economical, and accurate means of performing this type of adjustment and that results in a nearly linear proportional increase in the computer time required as the number of photographs is increased. Author

**N64-14309** Litton Systems, Inc., Waltham, Mass. Communications Sciences Lab.
**ADAPTIVE MEMORY RESEARCH**
G. Sebestyen Griffiss AFB, N.Y., Inform. Processing Lab., Nov. 1963 88 p refs
(Contract AF 30(602)-2959)
(RADC-TDR-63-371; AD-427825)

The state-of-the-art of automatic pattern recognition techniques and related hardware developments, with special emphasis on the use of the various adaptive memories reported in recent literature is surveyed. The relationship between pattern recognition problems and Air Force intelligence problems is discussed, and the manner in which pattern recognition methods may be applied to these problems is outlined. The better-known set of machine learning and recognition techniques are examined, described, and analyzed in a common terminology. The major activities in automatic photographic data processing (target recognition) conducted in various laboratories of the United States are discussed. Author

**N64-14310** Cornell U., Ithaca, N.Y.
**DETERMINATION AND DETECTION OF FEATURES IN PATTERNS**
H. D. Block, N. J. Nilsson and R. W. Duda (Stanford Res. Inst.) Griffiss AFB, N.Y., Inform. Process. Branch, Dec. 1963 57 p refs
(Contract AF 30(602)-2943; Contract Nonr-3438(00); Contract PHT-1-77B-62)
(RADC-TDR-63-467; AD-427840)

Feature determination as a method of training the first layer of weights in a two layer learning machine (Perceptron) is investigated. The problem is viewed as one of examining a set of patterns and determining a set of simpler patterns, or features, so that each of the original patterns can be formed by superposing the features. While the general problem of finding a minimal set of features was not solved, two algorithms were given that solve the problem for restricted pattern sets. Author

**N64-14418** Iowa State U. of Science and Tech., Ames Ames Lab.
**SCANF MACRO FOR THE IBM 7070/2/4**
T. R. Johnston Nov. 1963 16 p
(Contract W-7405-eng-82)
(IS-765) OTS: $0.50

The SCANF MACRO provides an easy means of scanning an area of core defined by a record definition word and determining the type of entities present and their context. The entities must be in alphameric form. Author

**N64-14437*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**COMPUTATION OF SATELLITE ORBITS BY THE HANSEN METHOD AS MODIFIED BY MUSEN**
Howard T. Phelan 1962 60 p refs Presented in a series of lectures at Goddard Space Flight Center, Oct. 1960
(NASA TR R-147) GPO: $0.55

A comprehensive description of the Hansen theory of satellite orbit calculation, as modified by Musen, is presented. The equations of the theory are developed in sufficient detail that they may be related to fundamental laws of celestial mechanics. The physical and mathematical concepts underlying Hansen's coordinate system and auxiliary ellipse are treated. The disturbing potential function and its derivatives are developed in the derivation of equations for the perturbations in the orbit plane, as well as the perturbations of the orbit plane. The method is described for determination of the final position and velocity vectors of the real satellite and determination of the osculating elements. A brief evaluation of the theory is presented. Author

**N64-14461** European Atomic Energy Community, Brussels (Belgium)
**THE GENERALIZED GRADIENT, ITS COMPUTATION ASPECTS AND ITS RELATIONS TO THE MAXIMUM PRINCIPLE**
W. De Backer, Joint Nucl. Res. Center, Ispra Estab. (Italy), Sci. Data Process. Center, 1963 18 p refs Presented at the IFAC-Congr., Basel, 27 Aug.–4 Sep. 1963
(EUR-411.e) Available from Belgian American Bank and Trust Co., N.Y. Account No. 121.86: 40 Belg. Fr.

The maximum principle and related theorems of the Pontryagin team lead to a generalization of the equations of steepest descent. This generalization comprises the introduction of dynamic stresses. In this way the state vector no longer moves along the steepest descent, but the $\psi$ vector of the adjoint system does. With respect to the simulation of the dynamic stresses and the technique of implicit computing of Lagrange multipliers, the analog computer appears to be appropriate for generalized gradient optimization. Author

**N64-14479** Maryland U., College Park
**SELF-ADJOINT DIFFERENTIAL OPERATORS OF THE PURE WAVE TYPE**
John Edward Lagnese (Ph.D. Thesis) 1963 63 p refs
(Contract DA-36-034-ORD-1486)
(AROD-407.63; AD-428572) OTS: $6.60

The equation $L_m u = u_{tt} - \sum_{i=1}^{m} u_{x_i x_i} + c(t)u = 0$, is studied from the point of view of determining explicitly the functions c(t) for which the form of this equation is Huygens'. Particular attention is given to the case m = 7. Also, another class of Huygens' operators is found, and general properties of the operators of the form of the above equation are studied. Author

**N64-14522** Joint Publications Research Service, Washington, D.C.
**PAGES FROM "THE DIGITAL SYSTEM OF STORING AND RETRIEVING INFORMATION (AI-2048)"**
A. F. Belov et al 27 Jan. 1964 46 p Transl. into ENGLISH from the book" "Tsifrovaya sistema nakopleniya i obrabotki informatsii (AI-2048)", Moscow, State Publishing House for Lit. on Nucl. Sci. and Eng., 1963
(JPRS-22930; OTS-64-21405) OTS: $1.25

The AI-2048 system is intended for measuring the space–time and statistical distributions of values and for the preliminary processing of the obtained information. The system contains the following: (1) input devices—the unit for converting pulse amplitudes to digital code, the unit for converting microsecond time intervals to digital code (time selector), the vernier-type unit for converting nanosecond time intervals to digital code, and the code-pulse generators for the detectors, samples, and targets; (2) the working memory; (3) the arithmetic unit; (4) the control unit; (5) the console unit; (6) output devices—the oscilloscope unit, the oscilloscope-control unit, the digital printer, and the punch servo; (7) the microprogram unit; and (8) the power supply. In using the AI-2048 system, its units and devices can be linked in different ways, thus permitting various measurements in nuclear physics and in the atomic industry. I.v.L.

**N64-14525** Joint Publications Research Service, Washington, D.C.
**MATHEMATICAL MODELING OF SOME TECHNOLOGICAL PROCESSES ON AN ELECTRONIC DIGITAL COMPUTER**
I. S. Lyubchenko and I. Ye. Mayzlin 3 Feb. 1964 13 p refs Transl. into ENGLISH of an article from Vestn. Mosk. Univ. (Moscow), no. 2, 1963 p 37–43 Presented at the VPTI Meeting of the Mosgorsovnarkhoz, 29 Jun. 1962
(JPRS-23041; OTS-64-21466) OTS: $0.50

This paper discusses the derivation of an algorithm that, on the electronic digital computer, models the operation of a mechanized production line of electric heating elements. At given intervals of time, the state of all of the components of the line is analyzed. It is assumed that the changes in the states may occur at the instants of time under investigation. These analyses of the system at fixed instants of time and the possible unfolding of the modeled process in time contribute, in a natural way, to the simplicity of the algorithm derivation and to the universality of the modeling method. I.v.L.

**N64-14545** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group

**VARIATIONAL PROBLEMS ON THE OPTIMIZATION OF CONTROL PROCESSES IN SYSTEMS WITH BOUNDED CO-ORDINATES**

V. A. Troitskii [1962] 23 p refs Transl. into ENGLISH from Prikl. Mat. i Mek. (Moscow), v. 26, no. 3, May–Jun. 1962 p 431–443
(MH-Transl. 385)

In the construction of optimal control processes, in most cases, only the restrictions superimposed on the control parameters are taken into account. In certain studies, an attempt has been made to consider, also, restrictions on the coordinates. In this paper, the optimization of control processes is studied for systems in which coordinates and controls are bounded, and a variational statement of the problem is given. The necessary conditions for the minimization of the corresponding functionals are stated and permit the construction of solutions to such problems. Author

**N64-14549** General Dynamics/Astronautics, San Diego, Calif.

**ON THE DIRECT NUMERICAL INTEGRATION OF A SYSTEM OF LINEAR SECOND-ORDER ORDINARY DIFFERENTIAL EQUATIONS**

Paul E. Wilson and Edward E. Spier 15 Nov. 1963 22 p refs
(GD/A 63-1021; ERR-AN-341)

A method is given for the direct numerical integration of a system of linear second-order ordinary differential equations. An existing algorithm, which was recently devised by Potters, is generalized so that two-point boundary value problems with disjoint boundary conditions may be treated. The solution of a sample problem is presented, and the numerical results are shown to be in favorable agreement with a closed-form solution. Author

**N64-14638** ARO, Inc., Arnold Air Force Station, Tenn.

**DEVELOPMENT OF A COMPUTER PROGRAM FOR THE ANALYSIS OF ONE-DIMENSIONAL MAGNETOHYDRODYNAMIC FLOW PROBLEMS**

D. R. Wilson, C. E. Clouse, and W. J. Schaetzle Arnold Eng. Develop. Center, Jan. 1964 62 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-215; AD-426358)

A general method has been developed for the analysis of one-dimensional magnetohydrodynamic channel-flow problems and is presented in this report. The basic differential equations for one-dimensional flow (influence coefficient equations) are discussed, and it is shown how the magnetohydrodynamic body force and joule heating are included. Methods are also presented for including the effects of area change, external heat exchange, and wall friction, and approximate methods for including real gas effects are mentioned. The resulting set of equations has been programed for solution on the IBM 7070 digital computer. A description of the computer program is given, and the complete FORTRAN listing of the main program and subroutines is presented. Author

**N64-14661** Air Force Cambridge Research Lab., Bedford, Mass.

**NEW METHODS OF SOLVING ALGEBRAIC EQUATIONS**

Kurt H. Haase Dec. 1963 50 p refs
(AFCRL-63-560; AD-427882)

The main problem of solving an algebraic equation which is of higher degree is that of factorizing the polynomial in a product of polynomial factors of degrees 1 and 2. A class of linear factors can be found with the aid of a power table. When these evident real roots are eliminated, the residue polynomial can be factorized in quadratic polynomial factors. A "table method" is devised by which coefficient approximations can easily be found, and methods are shown for use when solving a quartic equation and when solving a sextic equation. Author

**N64-14663** Air Force Cambridge Research Labs., Bedford, Mass.

**THE DECOMPOSITION OF FINITE STATE MACHINES Research Report**

Thomas V. Griffiths (M.S. Thesis—M.I.T.) Nov. 1963 107 p refs
(AFCRL-63-543; AD-427880)

This work is concerned with decomposition of a finite state machine into the Cartesian product of two smaller finite state machines. A notation is developed to treat the problem, and principal results of Hartmanis and Yoeli are given with some extensions. An addition operation on finite state machines is defined, and it is shown that the product operation distributes over the addition operation. It is shown that the output-free finite state machine is equal to the sum of a set of single-input, output-free finite state machines. Generating functions for transformation finite state machines are introduced, and it is shown how these may be used in obtaining the decomposition of a transformation finite state machine as the product of two smaller transformation finite state machines if such a decomposition exists. Author

**N64-14665** Stanford U., Calif.

**A GENERAL METHOD FOR NUMERICAL INTEGRATION THROUGH A SADDLE-POINT SINGULARITY WITH APPLICATION TO ONE-DIMENSIONAL NON-EQUILIBRIUM NOZZLE FLOW Final Report**

George Emanuel Arnold AFB, Tenn., Arnold Eng. Develop. Center, Jan. 1964 47 p refs
(Contract AF 40(600)-930)
(AEDC-TDR-64-29; AD-428563)

A general method for integrating numerically through a saddle-point singularity of an ordinary differential equation is presented. The solution of the differential equation is assumed to depend also on the value of a parameter, such as the mass flow. The method is thus applicable to a wide assortment of gas-dynamic problems including one-dimensional nonequilibrium nozzle flow and two-phase nozzle flow. Specific application is made to nonequilibrium nozzle flow, and the results of this application are presented and discussed. The method proved to be numerically accurate without requiring an exceedingly precise estimate for the critical mass flow. The work also includes a modification of the method for calculating approximate equilibrium nozzle flows. Author

**N64-14699** Air Force Cambridge Research Labs., Cambridge, Mass.

**ON A SYSTEM OF EQUATIONS RELATED TO A POLYNOMIAL**

Kurt H. Haase Nov. 1963 15 p ref
(AFCRL-63-533; AD-427883)

It is shown that $z^2 + y_1 z + x_1$ is a quadratic factor of the polynomial $f(z) = \sum_{k=0}^{n} A_k z^k$ if, and only if, the pair $(x_1, y_1)$ is a root of a system of other polynomials. Author

**N64-14700** Air Force Cambridge Research Labs., Cambridge, Mass.
**CANONICAL FORMS FOR ERROR PROBABILITIES IN BINARY BAYES DETECTION**
David Middleton Dec. 1963 36 p refs
(AFCRL-63-561; AD-427881)

Canonical relations are obtained for the (fixed-sample) error probabilities and distribution densities of optimum binary detectors in the "composite" situation involving the detection in noise of signals of one general class ($S_1$) vs signals of another general class ($S_2$). These canonical relations are expressed in terms of the appropriate distribution densities of the associated "on-off" cases $S_1$●N vs N, and $S_2$●N vs N, by which it is then often possible to carry out explicit and exact evaluations for the error probabilities in the corresponding "composite" cases where a direct approach fails or is extremely difficult. Specific use of these canonical relations is illustrated by several examples involving fixed signal amplitudes, slow Rayleigh fading, and decision rejection, in various combinations. The new results can be summarized from the tables and selected calculations. Author

**N64-14716** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**THE LINEAR VARIATION IS THE LENGTH OF THE CURVE**
T. S. Latysheva [1963] 12 p refs Transl. into ENGLISH from Izv. Akad. NAUK SSSR, Ser. Mat., (Moscow), no. 27, 1963 p 61–66
(MH-Transl. 443)

This paper proves the following theorem: Let the curve L be given by the equations $x = \phi(t)$ and $y = \psi(t)$, where $\phi(t)$ and $\psi(t)$ are continuously differentiable functions in $[\alpha,\beta]$ and $(\phi t)^2 + (\psi t)^2 \neq 0$, then the linear variation of the curve is equal to the length of this curve, multiplied by the constant coefficient, equal to $e/\pi$. Author

**N64-14718** Aberdeen Proving Ground, Md. Ballistic Research Labs.
**A FOURTH SURVEY OF DOMESTIC ELECTRONIC DIGITAL COMPUTING SYSTEMS**
Martin H. Weik, Jr. Jan. 1964 378 p refs
(BRL-1227; Supplements BRL-1115, PB-171265; AD-429000)

This report includes the results of a fourth survey of the engineering and programing characteristics of 112 different, electronic, digital computing systems that have been developed since 1961. The report describes the application; numerical and arithmetic characteristics; input, output, and storage systems; construction and checking features; power, space, weight, and site preparation and personnel requirements; production records, cost and rental rates, sale and lease policy; reliability, operating experience, and time availability; engineering modifications and improvements; and other related topics concerning the computing systems. Fifteen comparative tables are included. Author

**N64-14752** Minneapolis-Honeywell Regulator Co., St. Petersburg, Fla. Honeywell Military Products Group
**A SURVEY ON ADAPTIVE SYSTEMS WITH A DYNAMIC CHARACTERISTIC ADJUSTMENT**
R. S. Rutman Sep. 1962 50 p refs Transl. into ENGLISH from Avtomat. i Telemekh. (Moscow), v. 23, no. 5 p 661–684
(MH-Transl. 393)

A classification is presented of adaptive systems that are concerned with maintaining a performance index, and a survey is given of periodicals, books, and conference materials on adaptive systems with a dynamic characteristic adjustment. Basic principles and methods for their realization are selected for the construction of this type of system. The materials are generalized and systematized according to the most important criteria: the algorithms of the self-adjustment and the methods for determining the dynamic characteristics. Author

**N64-14762** California U., Berkeley Operations Research Center
**TABLE OF THE WAITING TIME DISTRIBUTION FOR THE CONSTANT SERVICE QUEUE (M/D/1)**
Robert M. Oliver 30 Sep. 1963 25 p refs
(Contract Nonr-222(83); NSF Grant 21034)
(ORC-63-12; AD-426483)

The single channel, constant-service queue with Poisson arrivals represents one of a variety of mathematical models in which customers demand service at a single facility. In this model, it is assumed that the times between arrivals are exponentially distributed random variables and that the service or holding time of each customer is a constant$\Delta$; hence, a completion of service occurs every $\Delta$ time unit when there are customers in the service facility. Tables of the probability distribution that the wait in queue is less than or equal to a given value were computed. R.T.K.

**N64-14763** California U., Berkeley Operations Research Center
**BOUNDS ON INTEGRALS WITH APPLICATIONS TO RELIABILITY PROBLEMS**
Richard E. Barlow 21 Oct. 1963 36 p refs
(Contract Nonr-222(83))
(ORC-63-27-(RR); AD-426482)

Certain statistical problems in life testing and reliability lead to the consideration of minimizing and maximizing certain integrals of the form $\int_0^x \phi(x, \bar{F}(x))\,dx$ $\bar{F}(x) = 1 - F(x)$ under the assumption that the distribution function F has increasing hazard rate and that one or two moments are given. The minimizing (maximizing) distributions for the special cases considered are members of the extremal class. Bounds on the expected values of the minimum and maximum order statistics as well as the operating characteristics of replacement policies based on age are obtained under these assumptions. Author

**N64-14764** California U., Berkeley Operations Research Center
**A PROOF OF FOUR-COLORING THE EDGES OF A REGULAR THREE-DEGREE GRAPH**
Ellis L. Johnson 24 Oct. 1963 11 p refs
(Contract Nonr-222(83))
(ORC-63-28(RR); AD-426484)

A study is made of the assignment of colors to the edges of a graph in such a manner that no vertex of the graph is incident to two edges of the same color. In the discussion a proof is given for coloring the edges of a three-degree graph, in such a way that no vertex would be incident to edges with the same colors, utilizing four colors. C.L.W.

**N64-14769** Michigan U., Ann Arbor
**DIGITAL COMPUTER ANALYSIS OF CONDENSATION IN HIGHLY EXPANDED FLOWS**
James L. Griffin Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Nov. 1963 108 p refs
(Contract AF 33(657)-8867)
(ARL 63-206; AD-428303)

The equations of the spontaneous nucleation theory of Frenkel are combined with the steady one-dimensional diabatic

flow equations for a solution of the expansion of a pure vapor. A digital computer program for the solution of these equations is compiled and presented. The theoretical prediction of the condensation of nitrogen is compared to experimental results, and variations in specific heat, latent heat of vaporization, surface tension, and rate of expansion are investigated. The theoretical calculation is applied to metal vapors, and the results for copper and zinc vapors are presented. The results indicate that the theoretical solution gives a reasonable prediction of the condensation in highly expanded flows. The degree of supersaturation increases with an increased rate of expansion; and for a proper set of initial conditions, condensation-free flow is obtainable. The rate of expansion and the surface tension are the most critical parameters in the equations for condensing flow. Author

**N64-14774** RAND Corp., Santa Monica, Calif.
**HIGHER-ORDER APPROXIMATIONS TO THE COMPUTATIONAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS**
Stanley Azen Jan. 1964 13 p refs
(ARPA SD-79; ARPA Order 189-61)
(RM-3917-ARPA; AD-429018)

Two techniques of approximating the solution to a partial differential equation are investigated. Using the first of these, the solution is approximated at each stage by a higher-order difference algorithm. The second technique is that of storing the function at each stage by a polynomial. Numerical results were obtained from a FORTRAN program applying these techniques to the equation $u_t = uu_x$. Author

**N64-14803** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**ON THE THEORY OF GENERALIZED DYNAMICAL SYSTEMS**
E. A. Barbashin [1962] 40 p refs Transl. into ENGLISH from Uch. Zap. Mosk. Gos. Univ. (Moscow), v. 14, no. 135 p 110–133
(MH-Transl. 380)

Questions are considered that concern the evaluation of dynamical systems that are subject to the choice of the system at each time. These problems arise when consideration is given to control of dynamical systems or to dynamical systems subject to unknown disturbances. General results are achieved concerning the axiomatic treatment of such systems. A precise definition is given for the contemporary theory of abstract dynamical systems that represent a widely branching field of science and whose basic problem is the study of sets, invariant for a certain one parameter group of automorphisms of the given topological space R. This treatment covers the determination of the generalized dynamical system, the integral funnels of the generalized dynamic system, and the trajectories in the generalized dynamic system. C.L.W.

**N64-14804** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**ON THE APPLICATION OF LYAPUNOV'S SECOND METHOD TO THE INVESTIGATION OF THE STABILITY OF MOTION OF NONLINEAR DISCONTINUOUS SYSTEMS**
A. H. Gelig [1962] 9 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. no. 7, 1962 p 58–61
(MH-Transl. 384)

In a series of articles dealing with the stability investigation of the motion of nonlinear systems of indirect automatic regulation by means of Liapunov's second method, continuous, single-valued, nonlinear functions are considered. It is proved in the present article that a number of results obtained for the nonlinear continuous systems remain valid for nonlinear systems with discontinuities of the first order. Author

**N64-14805** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**ON THE STABILITY OF THE TRIVIAL SOLUTION OF SECOND ORDER SYSTEMS**
B. S. Razumikhin [1962] 14 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 19, no. 3, 1955 p 279–286
(MH-Transl. 392)

The present article deals with the investigation of the stability of the trivial solution of second-order systems with two nonlinearities by means of Liapunov's direct method. Author

**N64-14806** Minneapolis-Honeywell Regulator Co., St. Petersburg, Fla. Honeywell Military Products Group
**ON THE CONTINUOUS DEPENDENCE OF THE SOLUTION TO ONE PROBLEM OF OPTIMAL REGULATION ON THE INITIAL DATA AND THE PARAMETERS**
F. M. Kirillova Oct. 1962 11 p refs Transl. into ENGLISH from Uspekhi. Mat. Nauk (Moscow), v. 17, no. 4, Jul.–Aug. 1962 p 141–146
(MH-Transl. 404)

The time optimal regulation of a system described by $dx/dt = f(x,t,\lambda) + B(t,\lambda)u(t)$ is considered. It is shown that the minimal time $T(x_0, t_0, \lambda)$ is the response time of the regulated system with $x(t_0) = x_0$. Author

**N64-14807** Minneapolis-Honeywell Regulator Co., St. Petersburg, Fla. Honeywell Military Products Group
**ON THE ALGORITHMIC COMPLEXITY OF DISCRETE FUNCTIONS**
Yu. Ofman [1962] 10 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 145, no. 1, 1962 p 48–51
(MH-Transl. 410)

The mapping of one set of binary sequences into another set by a collection of multilevel logic is considered. Complexity is in terms of the number of levels and number of logic elements. Author

**N64-14819** California U., Berkeley Operations Research Center
**A GRADIENT INEQUALITY FOR NON-DIFFERENTIABLE FUNCTIONS**
E. Eisenberg Sep. 1963 16 p refs
(Contract Nonr-222(83))
(ORC-63-25-(RR); AD-426873) OTS: $1.60

This report deals with a generalization of the following theorem: Assumption: K is an open subset of $R^n$, $f: K \rightarrow R$, f is differentiable on K, X is a convex subset of K, f is convex on X, $x_0 \in X$. Conclusion: $f(x_0) \leq f(x)$ for all $x \in X$ if, and only if, $(x - x_0)^T f'(x_0) \geq 0$ for all $x \in X$. The theorem will be generalized by relaxing the hypothesis that f is differentiable everywhere on K (and thus it shall be possible to omit mentioning K), though keeping the requirement that f be convex on X. In case it is known only that f is convex, it is still desirable to obtain nontrivial characterizations of the fact that f has a minimum on X and, if possible, to obtain some information about the minimizing point (i.e., $x_0$). It will be possible to obtain such characterizations when X and f are of special form, though f may fail to be differentiable. In acquiring a gradient inequality for nondifferentiable functions, the so-called Minkowski–Farkas lemma is frequently applied. I.v.L.

**N64-14833** Columbia U., New York, N.Y.
**PRIORITY QUEUES**
Lajos Takacs 3 Oct. 1963 23 p refs
(Contract Nonr-266(59))
(CU-38-63-Nonr-266(33)MS; AD-429065) OTS: $2.60

Customers of different priorities are arriving at a counter in accordance with a Poisson process. The customers are served by a single server in order of priority and for each priority in order of arrival. Two cases are considered: service with privileged interruptions, and service without interruption. It is supposed that the service times are mutually independent random variables having a prescribed distribution for each priority and independent of the arrival times. In both cases a simple method is given for finding the Laplace–Stieltjes transform and the moments of the stationary distribution of the waiting time for each priority level. Author

**N64-14837** Lincoln Lab., Mass. Inst. of Tech., Lexington
**COMPUTER PROGRAMS FOR PROCESSING SIGNALS RECEIVED IN RADAR ASTRONOMY EXPERIMENTS**
P. L. Fleck, Jr. and T. J. Goblick, Jr. 16 Aug. 1963 29 p refs
(Contract AF 19(628)-500)
(Rept. 64G-4; AD-429085)

This report contains: (1) a description of the general detection program, which was written mainly in FORTRAN; (2) a description of the basic Venus radar experiment; (3) a description of the data processing that should be performed to maximize the signal-to-noise ratio of received radar echoes, assuming the planet is a slowly fluctuating point target and the interference is additive gaussian noise; (4) a detailed list of the program parameters along with their use and format on input data cards, magnetic-tape unit usage, and FORTRAN stops built into the program; (5) a description of the new radar preprocessing equipment and associated program, known as the multifrequency program. I.v.L.

**N64-14897*** Wisconsin U., Madison Theoretical Chemistry Inst.
**THE INTEGRATION OF THE FIRST-ORDER PERTURBED WAVE EQUATION FOR EXCITED STATES OF ONE DIMENSIONAL SYSTEMS**
W. Byers Brown and Joseph O. Hirschfelder 15 May 1963 18 p refs
(NASA Grant NsG-275-62(4180); Contract AF 33(657)-7311)
(NASA CR-52965; WIS-TCI-13 Ser. 3) OTS: $1.60 ph, $0.80 mf

The explicit solutions of the first-order perturbation equations for a one-dimensional system can be obtained by quadratures, provided that the zeroth-order wave function does not have any nodes. Methods of integrating the equations are developed for excited states where the zeroth-order wave function has nodes. One of these methods is suitable for obtaining numerical solutions. Author

**N64-14914** European Atomic Energy Community, Brussels (Belgium)
**DESCRIPTION OF AN ALGORITHM FOR DOCUMENTARY ANALYSIS [DESCRIPTION D'UN ALGORITHME D'ANALYSE DOCUMENTAIRE]**
Y. Lecerf and A. Leroy Joint Nucl. Res. Center, Ispra Estab. (Italy), Dec. 1963 16 p refs In FRENCH; ENGLISH summary Presented at the 1st Congr. of the French Computing Assoc., Grenoble, France, 14–16 Sep. 1960
(EUR-336.f; CETIS-6) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 40 Belg. Fr.

A method for the automatization of the "analysis of documents" stage of documentation is presented. It is based on the idea that one rational way to express the content of scientific texts is to put it in diagram form. It is first demonstrated how a computer can pass to an intermediate representation, or "stemma." The next operation consists in establishing the semantic links between certain elements of a stemma or between elements of several stemmas, completed by a search for the solutions of problems of synonymia and polysemia by means of a "general diagram." This operation provides the representation in diagram form and this, again, leads to a completion of the general diagram. Author

**N64-14938*** National Aeronautics and Space Administration, Washington, D.C.
**ON NORMALLY EMBEDDED SETS OF NORMAL SPACES [O NORMAL' NO RASPOLOZHENNYKH MNOZHESTVAKH NORMAL' NYKH PROSTRANSTV]**
Yu. M. Smirnov Feb. 1964 9 p ref Transl. into ENGLISH by Faraday Translations from Mat. Sb. (Moscow), v. 29(71), no. 1, 1951 p 173–176
(NASA TT F-193) OTS: $0.50

A normally embedded set is defined. Five theorems concerning normally embedded sets of normal topo logical spaces are discussed, and mathematical proofs are developed. The term "space" is used to denote a completely regular topological space. Author

**N64-14942*** National Aeronautics and Space Administration, Washington, D.C.
**A NECESSARY AND SUFFICIENT CONDITION FOR THE METRICIZATION OF A TOPOLOGICAL SPACE [NEOBKHODIMOYE I DOSTATOCHNOYE USLOVIYE METRIZUYEMOSTI TOPOLOGICHESKOGO PROSTRANSTVA]**
Yu. Smirnov Feb. 1964 9 p refs Transl. into ENGLISH by Faraday Translations from Dokl. Akad. Nauk SSSR (Moscow), v. 77, no. 2, 1951 p 197–200
(NASA TT F-192) OTS: $0.50

A new solution of the general metricization problem is presented. It proves the following theorem: A necessary and sufficient condition for a topological space R to be metricizable is that the space be regular, and that in it there exist a denumerable set of locally finite coverings, the union of which is a basis of the space R. Author

**N64-14957** Minneapolis-Honeywell Regulator Co., Minn. Honeywell Military Products Group
**ON ONE STATISTICAL PROBLEM OF OPTIMAL CONTROL**
E. F. Mishchenko Apr. 1962 39 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mat. (Moscow), v. 25, no. 4, 1961 p 477–498

A functional of the controlled point is determined that indicates the probability measure for which the state vector is arbitrarily close to a random vector. The motion of the random vector is assumed to be due to a Markov process in which the probability density satisfies the parabolic second-order differential equation. Optimal values for the functional are obtained. Author

**N64-14959** Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.
**A STEEPEST-ASCENT SOLUTION OF MULTIPLE-ARC, VEHICLE OPTIMIZATION PROBLEMS**
R. G. Graham 19 Dec. 1963 32 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-362; TDR-269(4550-20)-3; AD-428902)

A steepest-ascent method for the simultaneous optimization of time-dependent functions and time-invariant quantities is developed. The method is based on the definition of a step size that combines the integral step associated with the time functions and the sum of squares step associated with the time-invariant quantities. The particular case of interest is the optimization of multiple-arc problems with the associated corner times. Using the properties of the adjoint system, a relationship describing the effects of small changes in the corner times is developed; and the generalized steepest-ascent method is applied to determine the optimum corner times and steering functions. Numerical examples are given to demonstrate the efficacy of the technique. Author

**N64-14963** Army Missile Command, Huntsville, Ala.
**DETERMINATION OF THE NUMBER OF MEASUREMENTS FOR THE ACHIEVEMENT OF A REQUIRED ACCURACY**
J. Tosovsky 31 Dec. 1963 9 p Transl. into ENGLISH from Zpravodaj Vyzkumny a Zkusebni Letecky Ustav (Czech.), v. 1, 1961 p 3-4
(RSIC-113; AD-428324)

A method is described, and a formula is derived by which the number of measurements needed to attain a prescribed accuracy, which was not attained in the first measurements, can be established. The calculus of probabilities with the t-division is used. Author

**N64-14995** Joint Publications Research Service, Washington, D.C.
**THE GEOLOGIST'S ELECTRONIC COMPANION**
R. Svoren' 17 Feb. 1964 6 p Transl. into ENGLISH from Izv. (Moscow), 7 Dec. 1963 p 1
(JPRS-23247; OTS-64-21572) OTS: $0.50

The EVM electronic computer recognizes oil-bearing strata on the basis of materials used by geophysicists. To that purpose several recognition programs were made, based on different ideas and mathematical methods. After being given 90 examples (45 oil-bearing layers and 45 water-bearing ones), the machine was tested. It was fed data on still unknown layers and, using the characteristics acquired in the course of its training, the machine expressed an "opinion" as to the layers in which oil should be detected. In going through 200 layers, it erred only four times. Geophysicists, using the same material, made 20 errors. I.v.L.

# 21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

**N64-14194** McGill U., Montreal (Canada) Stormy Weather Group
**ALBERTA HAIL STUDIES, 1962-1963 Scientific Report No. 1**
A. E. Carte, (NPRL, Pretoria), R. H. Douglas, R. C. Srivastava, and G. N. Williams Aug. 1963 124 p refs
(Contract AF 19(628)-249)
(MW-36; AFCRL-63-783; AD-426034)

CONTENTS:
1. SOME CHARACTERISTICS OF ALBERTA HAILSTORMS A. E. Carte 17 p refs (See N64-14195 06-21)
2. CONTINUITY OF HAIL PRODUCTION IN ALBERTA STORMS G. N. Williams and R. H. Douglas 39 p refs (See N64-14196 06-21)
3. SIZE DISTRIBUTIONS OF ALBERTA HAIL SAMPLES R. H. Douglas 20 p refs (See N64-14197 06-21)
4. ENTRAINMENT IN CUMULUS: A REVIEW R. C. Srivastava 29 p refs (See N64-14198 06-21)

**N64-14195** McGill U., Montreal (Canada) Stormy Weather Group
**SOME CHARACTERISTICS OF ALBERTA HAILSTORMS**
A. E. Carte *In its* Alberta Hail Studies, 1962-1963 Aug. 1963 17 p refs (See N64-14194 06-21)

Some characteristics of Alberta hailstorms are summarized as follows: (1) Radar echoes often extended to the left (north) of the swath, but never extended significantly beyond the right-hand (southern) boundary of the hail swath. (2) Hail swaths were orientated to the right of the upper winds. (3) Larger hail was dispersed less on either side of the spines than smaller hail. Also, the average duration at a point was longest at places which had the largest hail. (4) The most commonly observed sequence at a point was large hail, followed by smaller hail and rain. The reverse sequence prevailed in some storms even though the wind pattern was basically the same for all days studied. I.v.L.

**N64-14196** McGill U., Montreal (Canada) Stormy Weather Group
**CONTINUITY OF HAIL PRODUCTION IN ALBERTA STORMS**
G. N. Williams (M.S. Thesis) and R. H. Douglas *In its* Alberta Hail Studies, 1962-1963 Aug. 1963 39 p refs (See N64-14194 06-21)

Surveys conducted gave evidence of continuity of hailfall in that: (1) All reports indicated hailfall within the boundaries of the areas surveyed, suggesting a hail-generation process without important spatial gaps. (2) Maximum and most common hail sizes were largest near the centers of the swaths, and decreased towards the edges, as if the "activity" of hail production decreased more or less symmetrically from a central maximum. (3) There were no particular abrupt changes of behavior (i.e., the rain-hail sequence, and/or time of occurrence of the largest hail). The surveys also showed a tendency on which Carte had previously remarked, namely that, in storms in which the hail onset precedes that of the rain, the largest hail appears early in the hailfall; when the onset of rain precedes that of hail, the largest hail appears late in the hailfall. I.v.L.

**N64-14197** McGill U., Montreal (Canada) Stormy Weather Group
**SIZE DISTRIBUTIONS OF ALBERTA HAIL SAMPLES**
R. H. Douglas *In its* Alberta Hail Studies, 1962-1963 Aug. 1963 20 p refs (See N64-14194 06-21)

Size distributions of collected hail samples can be summarized by $N = 10\,M \exp(-2.93\,D)$, where NdD is the number of stones in the diameter range D to D + dD per $m^3$, M is the hail content of the air ($g/m^{-3}$), and D is the hail diameter in cm. I.v.L.

**N64-14198** McGill U., Montreal (Canada) Stormy Weather Group
**ENTRAINMENT IN CUMULUS: A REVIEW**
R. C. Srivastava *In its* Alberta Hail Studies, 1962-1963 Aug. 1963 29 p refs (See N64-14194 06-21)

A critical review of some 12 papers on the cloud dynamics of severe storms is presented, and two areas where future work is promising (and is now in process) are pointed out. These areas are the development of buoyancy of steady jets, and the accumulation of precipitation in the updraft. I.v.L.

**N64-14275*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**ATMOSPHERIC ACOUSTICS AS A FACTOR IN SATURN STATIC TESTING**
Richard N. Tedrick 1 Oct. 1963 143 p
(NASA-TM-X-51438; MTP-TEST-63-9) OTS: $11.00 ph, $4.49 mf

The engine noise resulting from the static testing of large space vehicles such as the Saturn S-I is both large in output power level and low in frequency. Under some meteorological conditions this energy may be focused by the atmosphere into relatively small areas on the earth's surface. To avoid the problems associated with such focal areas, a program of "selective firings" based upon acoustic and atmospheric soundings for the 36 hours prior to the test has been instituted. Acoustic measurements are made during the firing to verify the predicted sound pressure levels. This report details the theoretical basis and operational procedures for the selective firing program. Author

**N64-14329** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**TRANSACTIONS OF THE SCIENTIFIC-RESEARCH INSTITUTE OF HYDROMETEOROLOGICAL INSTRUMENT CONSTRUCTION, SELECTED ARTICLES**
D. Ya. Surazhskiy et al 16 Sep. 1963 81 p refs Transl. into ENGLISH from Tr. Naucho-Issled. Inst. Gidrometeorol. Priborostr. (USSR), no. 7, 1959 p 3-51
(FTD-TT-63-538/1+2+4; AD-425222)

CONTENTS:
1. THE AUTOMATIC RADIOMETEOROLOGICAL STATION (ARMS-N) D. Ya. Surazhskiy p 1-35 refs (See N64-14330 06-21)
2. RADIO TRANSMITTER OF THE AUTOMATIC RADIOMETEOROLOGICAL STATION (ARMS-N) N. I. Shteyn p 36-55 refs (See N64-14331 06-21)
3. AN AUTOMATIC RADIOMETEOROLOGICAL STATION FOR RESERVOIRS (ARIV-52) I. N. Mogil'ner and F. N. Shevchenko p 56-78 ref (See N64-14332 06-21)

**N64-14330** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**THE AUTOMATIC RADIOMETEOROLOGICAL STATION (ARMS-N)**
D. Ya. Surazhskiy *In its* Trans. of the Sci.-Res. Inst. Hydrometeorol. Instr. Construct., Selected Articles 16 Sep. 1963 p 1-35 refs (See N64-14329 06-21)

The ARMS-N station complex includes the following independent units and components that are electrically interconnected by cables: (1) the wind instrument unit; (2) the barothermometer unit with louvered shielding; (3) the rain gage; (4) the solar probe; (5) the control and coding unit; (6) the power-supply unit (the wind generator, rectifier, and the buffer storage battery); and (7) the radio transmitting device. The station operates independently without servicing for 12 months; and, at prescribed times, it automatically measures 6 meteorological elements, converts them into coded electrical pulses, and transmits these pulses in the form of Morse-code radio signals. I.v.L.

**N64-14331** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**RADIO TRANSMITTER OF THE AUTOMATIC RADIOMETEOROLOGICAL STATION (ARMS-N)**
N. I. Shteyn *In its* Trans. of the Sci.-Res. Inst. Hydrometeorol. Instr. Construct., Selected Articles 16 Sep. 1963 p 36-55 refs (See N64-14329 06-21)

The transmitting part of the ARMS-N consists of two transmitters on a single chassis, a common power-supply block for both transmitters, a separate tube socket (6P3S tubes are utilized) that permits the instrument to be switched in for measuring the total tube current for the separate stages, a keying relay, and two antenna relays. Each transmitter contains its own antenna-tuning elements. The antenna relays switch one or the other transmitter to the antenna (depending on daytime or nighttime transmission). The design of the transmitters and the units used in both transmitters are identical. The only difference is the choice of the rated circuit capacitors, which is dependent on the length of the transmitting waves. The keying relay keys the transmitter. The Morse-code signals from the meteorological sensors control the operation of the keying relay. I.v.L.

**N64-14332** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**AN AUTOMATIC RADIOMETEOROLOGICAL STATION FOR RESERVOIRS (ARIV-52)**
I. N. Mogil'ner and F. N. Shevchenko *In its* Trans. of the Sci.-Res. Inst. Hydrometeorol. Instr. Construct., Selected Articles 16 Sep. 1963 p 56-78 ref (See N64-14329 06-21)

The ARIV-52 consists of: (1) an anemometer; (2) a compass gage; (3) a thermohygrometer; (4) a water thermometer; (5) a control unit; (6) an autostarter; (7) a radio transmitter; (8) an antenna-mast; and (9) an electric power-supply unit. All components are connected by multiconductor electrical cables and are fastened inside a housing (a medium-size maritime hydrographic buoy) and on the 113.5-m-high truss installed on the buoy housing. The ARIV-52 operates automatically, without servicing, for the entire navigation season on the reservoir. The regime of the automatic switching in of the station can be set at will either hourly or every 6 hours (in a synoptic day) if it is windy on the reservoir and the average windspeed is not dangerous. The values of the meteorological elements measured by the station are received audibly by radio as combinations of Morse-code characters. I.v.L.

**N64-14340** Boeing Co., Renton, Wash. Airplane Div.
**METEOROLOGICAL ASPECTS OF THE SONIC BOOM Progress Report No. 3**
Dec. 1963 10 p
(Contract FA-WA-4717)

Airplane flight characteristics were run on a digital computer in 11 model atmospheres (without wind). The influence of pressure and temperature variations from the standard was studied. Hydrostatic equilibrium variation of pressure in the standard atmosphere seemed to have little effect on the shock-wave overpressure on the ground other than to increase or decrease the shock-wave strength in proportion to the increase or decrease in local ambient pressure. The effect of temperature variation alone seemed to be relatively small insofar as the sonic boom overpressure was concerned, especially at Mach numbers above 1.5. The effect of wind direction was also studied. It was found that differences in shock strength and location between an 8° tailwind and a direct tailwind are very small. R.T.K.

**N64-14347** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.

**METEOROLOGICAL DATA REPORT: AEROBEE AD 3.324**

Gordon L. Dunaway Dec. 1963 43 p refs

(ERDA-101; AD-428372) OTS: $4.60

Meteorological data gathered for the launching of Aerobee AD 3.324 are presented for the Air Force Cambridge Research Center and for ballistic studies. The data appear, along with calculated ballistic data, in Appendixes A, B, C, and D. Author

**N64-14348** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.

**METEOROLOGICAL DATA REPORT: AEROBEE NE 3.153**

Gordon L. Dunaway Dec. 1963 45 p refs (For abstract see N64-14347 06-21)

(ERDA-102; AD-428373) OTS: $4.60

**N64-14459** Chicago U., Ill.

**USE OF TIROS PICTURES FOR STUDIES OF THE INTERNAL STRUCTURE OF TROPICAL STORMS**

Tetsuya Fujita Oct. 1963 29 p refs Rectified Pictures by Toshimitsu Ushijima For TIROS I Orbit 125, R/O 128

(Grant Cwb WBG-6; Mesometeorology Proj.)

A series of TIROS I pictures of a South Pacific tropical storm, rectified with great accuracy, was used to study the fine structure of the storm. Three orientations of clouds-in-line were examined in an attempt to find their causes. The first orientation represents the direction of the low-level winds along which small cumuli align as a cloud street. The second corresponds to the so-called hurricane rainband and probably represents a streak line when large convective towers originate at a fixed source on the earth. The plumes of cirrus from high convective towers appear as the third orientation. A theoretical study leading to the determination of cloud height from shadow on the ocean surface was also made. Author

**N64-14493** RAND Corp., Santa Monica, Calif.

**COMPLETE MICROWAVE SCATTERING AND EXTINCTION PROPERTIES OF POLYDISPERSED CLOUD AND RAIN ELEMENTS**

D. Deirmendjian Dec. 1963 65 p refs

(Contract AF 49(638)-700; Proj. RAND)

(R-422-PR; AD-426139)

Determined are the extinction, the albedo of single scattering, the differential-scattering cross section, and the complete polarization properties, per unit volume of cloud and rain elements, when these elements are irradiated by microwave radiation at various frequencies. Continuous drop-size distribution functions are introduced to represent real clouds and precipitation, and the absorption and scattering parameters are integrated with high accuracy. A Rayleigh approximation is found adequate for the cloud model, but the complete Mie expressions had to be used for precipitation-sized particles. Older estimates have been corroborated, but some new features have been brought out for the first time, such as the scattered intensity and polarization (including its ellipticity) as a function of scattering angle. Author

**N64-14532** Joint Publications Research Service, Washington, D.C.

**TRANSLATIONS FROM PROBLEMY ARKTIKI I ANTARKTIKI [LENINGRAD] (PROBLEMS OF THE ARCTIC AND ANTARCTIC) NO. 14, 1963**

4 Feb. 1964 61 p refs Transl. into ENGLISH of 5 articles p 5–15, 17–26, and 41–59

(JPRS-23074; OTS-64-21484) OTS: $1.50

CONTENTS:

1. ON THE PROBLEM OF THE TRENDS AND COORDINATION OF RESEARCH ON LONG-RANGE METEOROLOGICAL FORECASTS A. A. Girs p 1–17 refs

2. A NUMERICAL METHOD OF COMPUTING ICE THICKNESS AND TEMPERATURE Yu. P. Doronin p 18–29 refs

3. SHORT-PERIOD DISTURBANCES OF SOLAR ACTIVITY AND POSSIBLE REASONS FOR THE AMBIGUITY IN THEIR CONNECTION WITH FLUCTUATIONS AND HYDROMETEOROLOGICAL ELEMENTS B. A. Sleptsov-Shevelich p 30–40 refs

4. THE ROLE OF METEOROLOGICAL CONDITIONS IN THE FORMATION OF THE SNOW-ICE SURFACE OF ANTARCTICA I. D. Kopanev p 41–48 refs

5. OCEANOGRAPHIC RESEARCH IN THE CENTRAL ARCTIC N. I. Blinov p 49–58 refs

**N64-14535** Joint Publications Research Service, Washington, D.C.

**HYDRODYNAMIC FORECASTING OF PRESSURE FIELDS IN THE MID-LEVEL OF THE ATMOSPHERE FOR THE ENTIRE SPHERE OF THE EARTH, TAKING OROGRAPHY INTO CONSIDERATION**

A. P. Boyko 6 Feb. 1964 11 p refs Transl. into ENGLISH of an article from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 6, 21 Dec. 1963 p 1303–1306

(JPRS-23108; OTS-64-21500) OTS: $0.50

Forecasting for the entire sphere of the earth begins with the nonlinear equation for a vortex transfer for the midlevel and the linearized balance equation: $\Delta\,\partial\psi/\partial\theta + 1/a_0^2 \sin\theta\,(\psi,\ \Delta\psi + 2\omega a_0^2 h) + 2\omega\,\partial\psi/\partial\lambda = 0$, $\cos\theta\Delta\psi - \sin\theta\,\partial\psi/\partial\theta = g/2(a+\omega)\Delta H$, written in a spherical system of coordinates $\theta$ (addition of latitude), $\lambda$ (longitude of the spot). Here $\psi$ is a current function; H is the height of the 500-mb isobaric surface; $\alpha$ is the weather-pattern index $h = \epsilon \cos\theta\, gh(\theta,\lambda)\, RT_1$, where $h(\theta\lambda)$ is the elevation of the surface of the earth above sea level; $T_1$ is the mean temperature of the entire atmosphere; $\epsilon$ is the relaxing multiplier ($\epsilon > 1$). (The remaining symbols are given in a reference). The problem breaks down into three separate problems: (1) the determination of the $\psi$ field for the initial moment of time, with respect to the known initial distribution of altitudes H; (2) the forecasting of $\psi$ for any moment of time; and (3) the determination of H with respect to the predicted values of $\psi$. The solutions to these problems are presented. I.v.L.

**N64-14569** Weather Bureau, Washington, D.C.

**METEOROLOGICAL STUDIES AS RELATED TO AEROSPACE NUCLEAR SAFETY**

Isaac Van der Hoven *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 209–218 refs (See N64-14551 06-01) OTS: $4.50

A major environmental problem in the use of nuclear rocket engines is at, or near, the launch pad before flight has been attained. The meteorological aspects of this localized aerospace nuclear-safety problem are discussed. Meteorology, as applied to the hazards of static nuclear rocket-engine tests and launches of missiles having a nuclear stage, may involve horizontal distances on the scale of tens of miles or may be limited to an area within a few thousand feet of the test point, depending upon the radioactive source strength and the prevailing atmospheric dispersion condition. The meteorological studies aimed at providing the necessary information for the

nuclear hazard evaluation can be divided into three problem areas that are considered in the present report: (1) the initial source configuration; (2) the mean atmospheric transport; and (3) the effect downwind, at the surface, of atmospheric diffusion and deposition. R.T.K.

**N64-14570** Atomic Energy Commission, Washington, D.C. Biology and Medicine
**FALLOUT PREDICTION TECHNIQUES**
J. Z. Holland and A. W. Klement, Jr. *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 219-229 (See N64-14551 06-01) OTS: $4.50

The three methods discussed are: (1) gravitational settling and turbulent diffusion of particles, (2) distribution into atmospheric reservoirs, and (3) analogy with debris from nuclear detonations. Following deposition on the surface, estimates of dietary and human levels may be made on the basis of a variety of empirical models embodying the available research results. R.T.K.

**N64-14618** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
**METEOROLOGICAL DATA REPORT: AEROBEE AC 3.511**
Marjorie Mc Lardie Hoidale Sep. 1963 38 p refs
(ERDA-69; AD-428618) OTS: $3.60

Meteorological data gathered for the launching of Aerobee AC 3.511 are presented along with calculated ballistic data. Author

**N64-14619** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
**METEOROLOGICAL DATA REPORT: LITTLE JOE II, QTV-1**
Gordon L. Dunaway Oct. 1963 34 p refs
(ERDA-84; AD-428619) OTS: $3.60

Meteorological data gathered for the launching of Little Joe II, QTV-1, are presented along with calculated ballistic data. Author

**N64-14620** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
**METEOROLOGICAL DATA REPORT: AEROBEE BSRA-02**
Marjorie Mc Lardie Hoidale Nov. 1963 37 p refs
(ERDA-90; AD-428620) OTS: $3.60

Meteorological data gathered for the launching of Aerobee BSRA-02 are presented along with calculated ballistic data. Author

**N64-14625** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
**METEOROLOGICAL DATA REPORT: AEROBEE NE 3.151**
Majorie Mc Lardie Hoidale Nov. 1963 45 p refs (For abstract see N64-14347 06-21)
(ERDA-91; AD-428621) OTS: $4.60

**N64-14759** Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia)
**DIVISION OF METEOROLOGICAL PHYSICS. ANNUAL REPORT FOR YEAR ENDING JUNE 30, 1963**
Jul. 1963 23 p refs

The fundamental processes in meteorology are studied along with the application of meteorological knowledge to the problems of economic importance, particularly those connected with agriculture and the efficient use of water. The areas discussed include: dynamical meteorology, general micrometeorology, agricultural meteorology and evaporation, radiative flux divergence in the earth's atmosphere, distribution and total amount of ozone in the atmosphere, and activities and personnel. C.L.W.

**N64-14765** Technical Operations Inc., Burlington, Mass.
**SUMMARY OF FINAL REPORT ON RESEARCH ON CIRCULATION IN NUCLEAR CLOUDS**
H. G. Norment 1 Dec. 1963 10 p refs
(Contract OCD-OS-62-186)
(TO-B-63-102A; AD-428706)

The current program status includes the following: (1) A relatively simple circulation model has been devised that, nevertheless, leans heavily for support on the fluid dynamic theory. Extrapolation into an observationally inaccessible portion of the clouds can be done with increased confidence by means of this model. Also, the model yields important insights into vital areas of interest such as cloud boundary, cloud rise and expansion rates, and the effects of these and other variable cloud properties on the strength of circulation. (2) Experimental circulation data have been obtained from cinefilms of nuclear test shots with the aid of a semiautomatic film analyzer. (3) The fluid dynamic circulation model has been programed for machine computation and incorporated into a particle-motion simulation program for operation on the IBM-7094 computer. Data have been obtained from pilot simulations. I.v.L.

**N64-14787** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
**METEOROLOGICAL DATA REPORT: AEROBEE NE 3.129**
Marjorie Mc Lardie Hoidale Oct. 1963 39 p refs (For abstract see N64-14347 06-21)
(ERDA-80; AD-429020) OTS: $4.60

**N64-14788** Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
**METEOROLOGICAL DATA REPORT: AEROBEE AD 3.151**
Marjorie Mc Lardie Hoidale Nov. 1963 45 p refs (For abstract see N64-14347 06-21)
(ERDA-92; AD-429022) OTS: $4.60

**N64-14789** White Sands Missile Range, N. Mex. Meteorological Support Div.
**METEOROLOGICAL DATA REPORT: AEROBEE AD 3.374 (AF-108)**
Marjorie Mc Lardie Hoidale Oct. 1963 45 p refs (For abstract See N64-14347 06-21)
(ERDA-86; AD-429021) OTS: $4.60

**N64-14870** Atomic Energy Commision, Washington, D.C.
**PROBLEMS OF NUCLEAR METEOROLOGY**
I. L. Karol and S. G. Malakhov, eds. Jan. 1964 335 p refs Transl. into ENGLISH by JPRS of a collection of articles from "Voprosy Yadernoi Meteorologii" Moscow, Gosatomizdat, 1962
(AEC-TR-6128) OTS: $4.00

Papers are presented that discuss investigations carried out in each of the following general areas: (1) radioactive isotopes in the atmosphere and their application for the study of atmospheric motions; (2) scavenging of radioactive aerosols from the atmosphere by precipitation; and (3) turbulent diffusion of an aerosol in the atmosphere. P.V.E.

**N64-14921** Joint Publications Research Service, Washington, D.C.
**RESULTS OF RADIATION MEASUREMENTS FROM SATELLITES IN A NON-ADIABATIC MODEL OF ATMOSPHERIC MOVEMENTS**
M. Ye. Shvets and B. Ye. Shneyerov 7 Feb. 1964 7 p refs Transl. into ENGLISH of an article from Dokl. Akad. Nauk SSSR, (Moscow), v. 152, no. 3, 1963 p 598–601
(JPRS-23129; OTS-64-21515) OTS: $0.50

A system of equations is derived for a nonadiabatic model of atmospheric movements. From these equations, the value of the radiation budget of the earth's surface can be computed by using direct measurements from satellites. This value can also be used for weather forecasting purposes. R.T.K.

# 22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

**N64-14203** National Research Council of Canada, Ottawa
**AN INVESTIGATION OF THE EFFECTS OF LATERAL-DIRECTIONAL CONTROL CROSS-COUPLING ON FLYING QUALITIES USING A V/STOL AIRBORNE SIMULATOR**
D. M. Mc Gregor Dec. 1963 30 p refs
(NRC 7778; LR-390)

A visual flight task which included hovering, accelerating and decelerating transitions, and steep angle approaches was used to give the pilots a realistic function to perform while assessing the various configurations. The results indicate quite a small area on the control cross-coupling graph over which the pilots' ratings were in the "Normal Operation" region, but a very large region for "Emergency Operation." A preference was indicated in both these regions for negative roll due to the pilots' yaw command input, and the shape of the emergency operation region showed that the pilots were more readily able to cope with favorable yaw due to roll input.
Author

**N64-14258** Perkin-Elmer Corp., Norwalk, Conn.
**READY FOR SKYHOOK. AIMING A 3-TON TELESCOPE HANGING FROM BALLOON**
E. R. Schlesinger Repr. from Electronics, 8 Feb. 1963 6 p refs Available from McGraw., N.Y.: $0.75

Staroscope II, an unmanned balloon-borne 36-in.-diam. astronomical telescope, is described. This telescope, which weighs over 3 tons and with its flight train is over 650 ft high, is designed to provide consistent 0.1-sec-arc resolution photographs for exposure times up to 1 hr. Features of the design include stellar guidance stabilization with a two-speed servo-control system, means for in-flight optical focusing, provision for in-flight programing of the optical and electrical system that selects different targets, and highly versatile command and telemetry links. R.T.K.

**N64-14940*** National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
**THE USE OF A TWO-DEGREES-OF-FREEDOM GYROSCOPE AS A SATELLITE YAW SENSOR**
Francis J. Moran Washington, NASA, Feb. 1964 39 p refs (NASA TN D-2134) OTS: $1.00

The ability of a two-degrees-of-freedom gyroscope to indicate yaw attitude in an orbiting earth-pointed vehicle is evaluated. The gyro is first studied as a separate orbiting unit under the influence of gimbal angle damping and torquing, and it is shown that the gyro indicates yaw position. The gyro is then inserted in the yaw attitude control loop of a vehicle in circular orbit. The stability characteristics are studied, and analog time histories illustrate the system dynamics and yaw-sensing characteristics of the gyro. The ability of the two-degrees-of-freedom gyro to indicate large yaw-angle offsets and to supply stabilizing information to the vehicle for these angles is described. A comparison is made between the performance of a two-degrees-of-freedom gyroscope and a roll-rate gyroscope as used in the vehicle yaw control loop. The two-degrees-of-freedom gyroscope shows considerable improvement over the roll-rate gyroscope.
Author

# 23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

**N64-14172** Utah U., Salt Lake City Inst. for the Study of Rate Processes
**REACTION KINETICS, THE THEORY OF LIQUIDS, AND OPTICAL ROTATION Progress Report No. 3, 1 Apr.–30 Sep. 1963**
Dennis Caldwell, Gilford Chappell, MarLynn James, Sheng Hsien Lin, and R. P. Marchi [1963] 9 p
(Contract DA-ARO(D)-31-124-G298)
(AD-428109)

The current program status includes: (1) Bond strengths have been found to be of prime importance in chemical kinetics. (2) In gas-phase abstraction, reactions of the type $H + RH \rightarrow H_2 + R_1$ (equation A) occur. The activation energy, $\epsilon$, is simply given by $\epsilon = \xi = N\eta$ (equation B). In equation (A) RH is a paraffin molecule, and R is the radical; $\xi$ in equation (B) is a constant, $\eta$ is the interaction parameter, and N is the number of C—H bonds directly surrounding the reactive C—H bond. (3) A satisfactory set of parameters for liquid $CCl_4$ has been obtained according to the significant structure theory of liquids. (4) The phonon theory has been applied to the thermal conductivity of liquids. (5) The properties of water have been calculated (by computer) using significant structures from a model in which a hydrogen-bonded structure is interspersed with molecules which freely rotate. (6) It was found that the contribution of magnitude of the interfacial resistance to the plate height of gas-liquid chromatographic columns depends on the value of the accommodation coefficient or the sticking probability for solute molecules hitting a liquid surface of different chemical composition from the vapor. (7) The Rosenfeld equation has been applied to the calculation of optical rotation according to several models. I.v.L.

**N64-14184** Princeton U., N.J. Frick Chemical Lab.
**TABLES OF DIELECTRIC CONSTANTS, DIPOLE MOMENTS, AND DIELECTRIC RELAXATION TIMES**
Ralph D. Nelson, Jr. *In* Natl. Acad. of Sci.-Natl. Res. Council. Dielectrics. Dig. of Lit., Vol. 26, 1962 1963 p 27–99 refs
(See N64-14182 06-01)

The following tables are given: (1) static dielectric constant of pure liquids; (2) static dielectric constants of pure solids; (3) dipole moments; (4) unresolved relaxation times; (5) resolved relaxation times; (6) extrapolated dielectric constant at infinite frequency for pure liquids; and (7) cross-reference list for dipole type. R.T.K.

**N64-14185** Tufts U., Medford, Mass.
**MOLECULAR AND IONIC INTERACTIONS IN DIELECTRICS**
Karl H. Illinger *In* Natl. Acad. of Sci.-Natl. Res. Council. Dielectrics. Dig. of Lit., Vol. 26, 1962 1963 p 99–116 refs (See N64-14182 06-01)

In this annotated bibliography the following topics are included: dipole moments, ultraviolet and optical dispersion, infrared dispersion, microwave dispersion of gases, relaxation phenomena in liquids, dielectric constant and loss in solids, electrical properties of free electrons, plasma dielectrics, static dielectric constant, resistivity of solids, Faraday effect in solids, electrets, miscellaneous theoretical and experimental work, and journals, books reviews, and conferences. R.T.K.

**N64-14187** London U. (Gt. Brit.) Queen Mary Coll.
**THE BREAKDOWN OF DIELECTRICS**
B. W. Ward, T. J. Gallagher, and B. Salvage *In* Natl. Acad. of Sci.-Natl. Res. Council Dielectrics Dig. of Lit., Vol. 26, 1962 1963 p 157–185 refs (See N64-14182 06-01)

An annotated bibliography is presented on: (1) breakdown of gases—books and conferences, fundamental processes, uniform fields, nonuniform fields, and vacuum breakdown; (2) breakdown of liquids—conduction, breakdown, and reviews and books; (3) breakdown involving solids—electric strength studies of solids, gas discharge and partial failure, and system components. R.T.K.

**N64-14205*** United Aircraft Corp., East Hartford, Conn.
**LOW ENERGY CESIUM ION – ATOM COLLISION CROSS SECTIONS**
Robert H. Bullis *In* Inst. of Elec. and Electron. Engr. Rept. on the Thermionic Conversion Specialist Conf., Oct. 7–9, 1963 p 1–9 refs (See N64-14204 06-01) GE Res. Lab., $15.00
(NASA Contract NASr-112)

The cesium ion–atom total collision cross section has been measured over the energy range of 0.1 to 10 ev. A modified Ramsauer collision chamber, in which contact potential differences have been eliminated, was employed in the measurements. The basic concept employed in these measurements was to produce a completely field-free region in which the energy of the ion beam can be uniquely determined and in which the collisional event can take place. Cesium ions were produced by contact ionization of cesium atoms on a hot tungsten surface. The cesium ion–atom total collision cross section measured at an ion energy of 0.12 ev was 24,185 $P_c$ (number of collisions per centimeter of path at one millimeter gas pressure). At an ion energy of 9.7 ev the measured cross section was 5,415 $P_c$. Author

**N64-14206*** United Aircraft Corp., East Hartford, Conn.
**COLLISION CROSS SECTION OF LOW ENERGY ELECTRONS WITH CESIUM ATOMS**
Richard K. Flavin and Russell G. Meyerand, Jr. *In* Inst. of Elec. and Electron. Engr. Rept. on the Thermionic Conversion Specialist Conf., Oct. 7–9, 1963 p 10–16 refs (See N64-14204 06-01) GE Res. Lab., $15.00
(NASA Contract NASr-112)

The electron cyclotron resonance absorption technique has been used to measure the collision frequency for momentum transfer between electrons and cesium atoms over an electron energy range of 650° to 975° K. The measurements were made under the conditions of thermal ionization equilibrium (Saha equilibrium) using a microwave spectrometer capable of monitoring power absorptions as low as $10^{-16}$ watts. The assumption of pressure broadened spectral lines is completely validated by these measurements. In order to interpret the absorption spectra, the collision frequency velocity dependence was assumed to vary as $\nu_c = A + Bv^h$ where A, B, and h are constants. The collision probability $P_c$ was found to vary between values of 2050 to 2700 $cm^{-1}$ mm $Hg^{-1}$ with a maximum value occurring at approximately 880° K. Author

**N64-14211*** Radio Corp. of America, Princeton, N.J. RCA Labs.
**A DIMENSIONLESS PARAMETER CHARACTERIZING ELECTRON EMISSION S-CURVES**
Jules D. Levine *In* Inst. of Elec. and Electron. Engr. Rept. on the Thermionic Conversion Specialist Conf., Oct. 7–9, 1963 p 202–205 refs (See N64-14204 06-01) GE Res. Lab., $15.00
(NASA Contract NAS3-2531)

A simple approximate analysis of S-curves is given for different adsorbates, substrates, and arrival rates. The range of interest is the rising part of the S-curve at which the equation of state is simple and many cesium-coated thermionic emitters operate. The analysis is general in the sense that it does not rely on a particular model of the adsorption bond, and that it applies to many combinations of adsorbate, substrate, and arrival rate. R.T.K.

**N64-14223** Raytheon Co., Wayland, Mass. Advanced Development Lab.
**ON ERROR ESTIMATION IN QUANTUM STATISTICS PERTURBATION THEORY, CHAPTER 4 Scientific Report No. 5**
William A. Janos *In its* Invest. of Microwave Coupling and Energy Partition and Transport within a Plasma, Vol. 2 Feb. 1963 Repr. from J. Math. Phys, v. 41, no. 4, Dec. 1962 p 246–253

The error in using the first N terms in the perturbation expansion is shown to be bounded from above by a quantity of the order of the $N^{th}$ power of the absolute maximum difference in eigenvalues between perturbed and unperturbed Hamiltonian, the so-called spectral norm of the perturbing Hamiltonian. Having the representation and bound of the density matrix approximation, an upper bound was then obtained for the error in approximating the expectation value, the ratio of traces, by the first N terms of the density matrix perturbation series. The utility of this bound depends on the finite dimensionality of the dynamical operator, and is therefore restricted to angular momentum-like variables. The expectation-value error bound is shown to converge to zero geometrically with increasing terms as the ratio of the above spectral norm of the perturbation Hamiltonian to the magnitude of the trace of the approximation to the density matrix. This latter denominator therefore displays the expected strong field angular-momentum decoupling effect for purely spin systems. R.T.K.

**N64-14228** Hanford Atomic Products Operation, Richland, Wash.
**SWELLING OF IRRADIATED FISSIONABLE MATERIALS**
R. D. Leggett, B. Mastel, Y. E. Smith, D. J. Bailey, and J. W. Weber *In its* Met. Res. Operation 15 Oct. 1963 p 3.15–34 (See N64-14226 06-01) OTS: $3.50

The basic processes responsible for the behavior of uranium irradiated at temperatures in the high alpha region, where swelling is known to be important, were investigated. Activities are reported as follows: irradiation program, postirradiation examination, pulse annealing, and second phase distribution in dilute alloys of uranium. R.T.K.

**N64-14232** Hanford Atomic Products Operation, Richland, Wash.

**IRRADIATION EFFECTS**

A. L. Bement, J. E. Irvin, R. G. Hoagland, K. R. Wheeler, and J. W. Carter *In its* Met. Res. Operation 15 Oct. 1963 p 4.50–126 refs (See N64-14226 06-01) OTS: $3.50

An investigation was made of the combined effects of irradiation and reactor environment on the properties of structural materials. A number of materials were studied for applications in various temperature ranges. Included among the specimens tested were: Zircaloy-2 bend specimens, Hastelloy X-280 tensiles, and nickel-base tensiles. R.T.K.

**N64-14233** Hanford Atomic Products Operation, Richland, Wash.

**RADIATION-DAMAGE EXPOSURE UNITS**

R. E. Dahl and H. H. Yoshikawa *In its* Met. Res. Operation 15 Oct. 1963 p 4.127–130 (See N64-14226 06-01) OTS: $3.50

A criterion to define neutron exposure units is proposed and applied to several materials. The exposure unit proposed is the number of neutrons per square centimeter having energies above a specified energy limit $E_L$. The energy limit is specified by the condition that the integrated flux above $E_L$ be proportional to gross displacement production for the spectra under consideration. Plots demonstrating (1) the displacements in iron in various spectra, and (2) the value of $E_L$ as a function of atomic mass for beryllium, carbon, aluminum, silicon, iron, zirconium, and tungsten are presented. R.T.K.

**N64-14234** Hanford Atomic Products Operation, Richland, Wash.

**DAMAGE MECHANISMS**

F. A. Smidt and B. Mastel *In its* Met. Res. Operation 15 Oct. 1963 p 4.131–134 refs (See N64-14226 06-01) OTS: $3.50

An investigation was conducted to determine the role of interstitial impurities in alpha iron. Tensile tests were run on two experimental Ti–Fe alloys. The engineering stress–strain curves for these alloys are presented. The complete absence of a yield point and inhomogeneous yielding was noted. A series of tests on the strain rate sensitivity of the lower yield point of "Ferrovac-E" were run over the strain rate range of 0.002 $min^{-1}$ to 2.0 $min^{-1}$, and the results are included. The behavior of several foils of iron irradiated to neutron exposures of $5 \times 10^{18}$ nvt and $1 \times 10^{19}$ nvt (E>1 Mev) is discussed. R.T.K.

**N64-14237** National Physical Lab., Teddington (Gt. Brit.) Aerodynamics Div.

**EFFECT OF LAMINAR BOUNDARY LAYER DEVELOPMENT ON SPECTRUM-LINE REVERSAL TEMPERATURE MEASUREMENTS: DISPERSION LINE PROFILE**

D. Schofield 17 Jun. 1963 9 p refs

(NPL AERO-1018; A.R.C. 24883)

An extension of Lapworth's report on the effect of laminar boundary-layer development in a shock tube on spectrum-line reversal-temperature measurements is summarized. The extension consists of introducing the effect of the spectral line shape. Numerical calculations were made for a line with a pure dispersion profile. Results indicate that: (1) The sample is optically thick under the conditions of typical reversal experiments. The lowering of reversal temperature by an emitter with a dispersion profile (the whole profile is used) will be independent of emitter concentration (this affects the free-stream temperature). For a laminar boundary layer, it will grow with $\sqrt[4]{t}$, where t is the mean time between oscillations. (2) The extent to which the emitting species persists in the cool boundary layer requires a separate analysis. It would seem possible to bypass boundary-layer effects entirely by using nonresonance lines. I.v.L.

**N64-14238** National Physical Lab., Teddington (Gt. Brit.) Aerodynamics Div.

**A NOTE ON THE HOWLING OF EJECTOR SHROUDS**

P. Bradshaw 18 Apr. 1963 29 p refs

(NPL AERO-1064; ARC-24711)

Howling is shown to be an organ-pipe oscillation, maintained by naturally-occurring pressure fluctuations and not by feedback to the jet from the sound field. The spectral density of the pressure fluctuations near the organ-pipe frequency, and thus the acoustic efficiency, reach a maximum at jet Mach numbers of 0.3 to 0.5. Doppler damping is important at higher speeds. Refraction by radial temperature gradients may inhibit howling on jet-engine shrouds. Author

**N64-14240** Los Alamos Scientific Lab., N. Mex.

**LOSS OF ZIRCONIUM AND URANIUM FROM FLUIDIZED BEDS OF ZrC AND UC-ZrC PARTICLES AT HIGH TEMPERATURES**

A. C. Juveland, H. P. Deinken, and J. E. Dougherty 31 Dec. 1963 50 p refs

(Contract W-7405-eng-36)

(LAMS-2994) OTS: $1.25

The mass loss rates of uranium and zirconium from beds of UC–ZrC particles fluidized by helium or hydrogen have been measured in the temperature range of from 2300° to 2700° C. The particle sizes, bed depths, and fluidizing gas flow rate were varied over a wide range, and it appears that the exit gas was in chemical equilibrium with the particles. The loss rate of U seemed to be largely controlled by diffusion in the solid particles. The loss rates were considerably larger when hydrogen rather than helium fluidizing gas was used. Some chemical reactions involving the formation of $C_2H_2$ are suggested that explain most of the Zr losses when $H_2$ was used. Indications are that reactions involving $CH_4$ did not have time to occur during the transit time of a volume element of the gas stream. Author

**N64-14242** Calif. Inst. of Tech., Pasadena Firestone Flight Sci. Lab.

**THE ENGINEERING ANALYSIS OF LINEAR PHOTOVISCOELASTIC MATERIALS**

M. L. Williams and R. J. Arenz Jun. 1963 52 p refs Presented at the SESA Ann. Meeting, 6–8 Nov. 1963

(GALCIT SM 63-19)

The main requirements for practical photoviscoelastic analysis is optical and mechanical characterization of the material. The paper describes the interrelation between the stress and strain optic (operational) coefficients and approximate techniques for obtaining satisfactory quantitive results using broadband, rather than three- or four-element, representation of the material properties. Author

**N64-14246** Oak Ridge National Lab., Tenn.
**CALCULATIONS OF THERMAL-NEUTRON FLUX DISTRIBUTIONS IN CONCRETE-WALLED DUCTS USING AN ALBEDO MODEL WITH MONTE CARLO TECHNIQUES**
V. R. Cain (M.S. Thesis—Tenn. U.) 27 Jan. 1964 194 p refs
(Contract W-7405-eng-26; Order DASA-EO-800-63)
(ORNL-3507) OTS: $2.75

One series of calculations was performed for straight ducts so that comparisons could be made with the Simon–Clifford analytic approximation. Another series was for three-legged rectangular ducts similar to those used in a Tower Shielding Facility experiment. When an albedo similar to that to be expected for a pure thermal-neutron source was used, the results agreed very closely with the TSF data. A digital computer code was written to perform the calculations. Author

**N64-14247*** Oak Ridge National Lab., Tenn.
**SPACE VEHICLE SHIELDING STUDIES. PART II: THE ATTENUATION OF SOLAR FLARES BY ALUMINUM SHIELDS**
R. G. Alsmiller, Jr. and J. E. Murphy 24 Jan. 1964 28 p refs
(Contract W-7405-eng-26; Supported by NASA)
(ORNL-3520) OTS: $0.50

Using the straight-ahead approximation, nucleon–meson cascade calculations have been carried out for several solar-flare proton spectra incidents on a shield. The shield material has approximately the properties of aluminum. Both spherical-shell and slab geometries are considered. Author

**N64-14268*** National Bureau of Standards, Boulder, Colo.
**CRYOGENIC RESEARCH AND DEVELOPMENT FOR PERIOD ENDING SEPTEMBER 30, 1963. Progress Report No. II**
(NASA ORDER R-45)
(NASA CR-55324; NBS-7979) OTS: $4.60 ph, $1.52 mf

The following are discussed: (1) physical properties of cryogenic fluids—thermodynamic and transport properties, and the dielectric constant; (2) cryogenic meteorology—temperature transducer, pressure transducer, liquid-level transducer, density and quality measurement, flow measurement, Nerva instrumentation, and analog simulation; (3) consultation and advisory services—Project Centaur, Project Rover, and Project Nerva; (4) the compilation of thermophysical properties of cryogenic materials—thermodynamic properties of the cryogenic fluids, additional thermophysical properties for cryogenic materials, and summary charts of all tasks under this project; and (5) research on cool-down of cryogenic transfer lines—experimental, semiempirical, and theoretical studies. R.T.K.

**N64-14273*** National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
**THERMODYNAMIC PROPERTIES OF NEON**
R. D. Mc Carty and R. B. Stewart [1963] 17 p refs Presented at the Cryog. Eng. Conf., Boulder, Colo., 19–21 Aug. 1963 Submitted for Publication
(NASA Order R-45)
(NASA CR-55326) OTS: $1.60 ph, $0.80 mf

Analytical functions for calculating values of pressure, volume, temperature, internal energy, enthalpy, and entropy of neon are presented for temperatures from 25° to 300° K with pressures to 200 atm. The thermodynamic properties have been calculated by means of an equation of state fitted to selected experimental and theoretically derived P-V-T data; the results are illustrated on a temperature–entropy diagram. The accuracy with which the equation of state represents the P-V-T data in the ranges of temperature and pressure where experimental measurements have been reported is comparable to the accuracy of the experimental data, with the exception of the very precise ambient temperature data. Author

**N64-14277*** Stevens Inst. of Tech., Hoboken, N.J.
**THEORETICAL AND EXPERIMENTAL ASPECTS OF THE ELECTROHYDRODYNAMICS OF SUPERFLUID HELIUM AND FOCUSSING OF PHONONS IN SUPERFLUID HELIUM BELOW 0.5° KELVIN Final Report**
Jack Fajans and Carol Rosen Sep. 1963 34 p refs
(NASA Grant NsG-130-61)
(NASA CR-55303; SIT-P102 (9/63)) OTS: $3.60 ph, $1.22 mf

The topics discussed are: (1) the electrodynamics of superfluid helium in narrow channels; (2) the macroscopic modes of He II; (3) the use of electric fields in the investigation of the structure of liquid and solid helium; (4) the construction of a new cryostat and associated equipment for measurements of critical velocities and the effect of electric fields on critical flow; and (5) an apparatus for focusing phonons in superfluid helium. R.T.K.

**N64-14278*** California Inst. of Tech., Pasadena
**ELECTRON CAPTURE IN STELLAR INTERIORS**
John N. Bahcall 1963 47 p refs
(Partially supported by NASA; ONR)
(NASA-CR-55319) OTS: $4.60 ph, $1.61 mf

The reasons why nuclear electron-capture rates in stars depend on temperature and density are discussed, and some astrophysical applications of continuum electron-capture rates are reviewed. The modern theory of nuclear beta-decay is then used to calculate stellar continuum electron-capture rates for transitions of an arbitrary degree of forbiddenness. The equations that are most useful for astrophysical applications are discussed in detail; particular emphasis is placed upon methods for predicting stellar rates that utilize, whenever possible, terrestrial measurements. Three examples are discussed that illustrate the use of the formulas given in this paper: the electron-capture lifetime of a proton; the stellar beta-decay of $K^{40}$; and the effect of forbidden transitions on the abundances of elements in the iron peak. Author

**N64-14285*** Arizona U., Tucson Engineering Research Labs.
**DETECTION TECHNIQUES FOR TENUOUS PLANETARY ATMOSPHERES First Semiannual Report, 1 Jun. 1963–1 Jan. 1964**
Stuart A. Hoenig and Melvin M. Eisenstadt [1964] 13 p refs
(NASA Grant NsG-458)
(NASA CR-55379) OTS: $1.60 ph, $0.80 mf

Developments in the following areas of investigation are discussed: chemisorption detector for oxygen, thoriated tungsten filament for oxygen detection, chemisorption detector for hydrogen, molecular-beam systems, and molecular-beam detectors. P.V.E.

**N64-14291*** National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
**A COMPARISON OF TWO MELTING-PRESSURE EQUATIONS CONSTRAINED TO THE TRIPLE POINT, USING DATA FOR ELEVEN GASES AND THREE METALS**
Robert D. Goodwin and Lloyd A. Weber 6 Oct. 1963 27 p refs
(NASA Order R-45)
(NASA CR-55331; NBS-TN-183) OTS: $2.60 ph, $1.01 mf

Parameters have been determined by a least-squares method for the reduced Simon equation and for a new, empirical

melting equation using data for $H_2$, $D_2$, $T_2$, Ne, Ar, Kr, Xe, $N_2$, $O_2$, $CO_2$, $H_2O$, Na, K, and Hg. The new equation, $(P-P_t)/(T-T_t) = Ae^{xp}(-\alpha/T) + BT$, represents experimental data with essentially the same accuracy as the Simon equation. It provides a sensitive difference method for graphical examination of data.
Author

**N64-14305** Washington U., Seattle Coll. of Engineering
**POLE CONTRIBUTIONS TO ELECTROMAGNETIC FIELDS IN THE LIGHT OF A MODIFIED SADDLE POINT TECHNIQUE**
Gary D. Bernard and Akira Ishimaru Oct. 1963 48 p refs
(Contract AF 19(628)-2763)
(Tech. Rept. 82; AFCRL-63-565; AD-427361)

When a pole is present in the integrand, such as that corresponding to a leaky or slow wave, the approximation in common use is to take the first saddle point term obtained by ignoring the pole, plus a residue term if the pole in question has been captured in the deformation of the original path of integration. This approximation gives rise to a diagram for the pole contribution to the total solution that is present only in the wedge-shaped region defined by the definition angle and the horizontal. Applying an available modified saddle point technique involving the complementary error function to the fields of undirectional and bidirectional traveling waves, this report clarifies the range of usefulness of this approximation and of the diagrams.
Author

**N64-14306** Aerospace Corp., El Segundo, Calif. Labs. Div.
**CONTINUOUS ABSORPTION COEFFICIENTS OF CHLORINE**
Roger L. Wilkins 10 Jan. 1964 19 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-251; TDR-269(4230-10)-1; AD-427845)

Continuous absorption coefficients of chlorine have been calculated at wavelengths between 4,000 and 2,300A for temperatures from 291° to 2,400° K. The necessary partial absorption coefficients were calculated on a high-speed electronic digital computer. The resulting total absorption coefficients for chlorine agree well enough with the available experimental data to verify existing theory.
Author

**N64-14317** Air Force Systems Command, Wright-Patterson AFB, Ohio Directorate of Materials and Processes
**OBSERVATION OF MAGNETIC DOMAINS BY MEANS OF THE BITTER COLLOID METHOD [Final Report, Oct. 1961-Jun. 1962]**
Robert J. Patton and Karl J. Strnat Mar. 1963 27 p refs
(ASD-TDR-63-83; AD-405061)

Experimental equipment has been developed for the light-microscopic observation of ferromagnetic domains by means of the Bitter technique. The design of an electromagnet microscope stage that can accommodate both bulk samples and thin sheet strips is described. The formula for the preparation of the colloidal iron oxide solution is given. Photographs of domains on silicon–iron transformer sheet illustrate the quality of the pictures and the resolution that can be obtained with the setup.
Author

**N64-14341** Electro-Optical Systems, Inc., Pasadena, Calif.
**IONIZATION OF CESIUM ON POROUS TUNGSTEN**
A. T. Forrester, G. Kuskevics, and B. Marchant Nov. 1963 21 p refs Presented at the 14th Intern. Astronautical Congr., France, Jul. 1963
(Contracts AF 33(657)-8157; Contract AF 33(657)-10980)
(EOS-RR-17)

Observations were made with the ion-emission microscope indicating that previous theories of cesium ion emission from porous tungsten ionizers are inadequate. On the basis of the analysis presented, certain qualitative inferences are drawn: (1) The coexistence of several states is physically and mathematically understood. (2) The existence of discrete states and of critical phenomena must disappear for very fine pores. (3) The most favorable operation for large pores is from ion emission predominantly from the pores.
R.T.K.

**N64-14362** Stockholm U., (Sweden) Inst. of Theoretical Physics
**THEORETICAL INVESTIGATIONS OF THE ELECTRONIC STRUCTURES AND STATES OF MOLECULES AND CRYSTALS Third Quarterly Technical Status Report, 1 Sep.-30 Nov. 1962**
Inga Fischer-Hjalmars and Stig Flodmark [1962] 4 p refs
(Contract DA-91-591-EUC-2270)
(E-359-P; AD-428394) OTS: $1.10

Progress is reported in the BESK program for the ligand-field treatment. A FORTRAN II program has been written for the IBM 7090 to calculate the electron density in any molecule of 50 or less atoms, for wave functions that are antisymmetric products of molecular orbitals given as linear combinations of atomic orbitals of s, p, and d types. Another FORTRAN program for construction of symmetry projection matrices and the procedure of their diagonalization has been started.
J.E.T.

**N64-14367** Ohio State U. Research Foundation, Columbus
**THE $^2$PI – $^2$SIGMA EMISSION BANDS OF CN Scientific Report No. 1**
Hasel James Slone, Jr. (M.S. Thesis) Oct. 1963 52 p refs
(Contract AF 19(604)-6150)
(AFCRL-63-781; AD-428182)

The $^2\pi$-$^2\Sigma$(0,0) emission band of CN was observed in the region of 8,360 $cm^{-1}$ to 8,900 $cm^{-1}$ using a high resolution prism-grating infrared spectrometer. The $^2\pi$-$^2\Sigma$(0,1) and (1,2) bands of the same molecule were observed in the region from 6,525 $cm^{-1}$ to 7,160 $cm^{-1}$. The source was a fuel-rich oxyacetylene flame. However, instead of using pure oxygen as the oxidant, $N_2O$ was used with only enough oxygen added to keep the flame from blowing out. An analysis of the bands has been made, and values are given for the molecular constants of the molecule.
Author

**N64-14373** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**ATOMIZATION OF STAINLESS STEEL AND TANTALUM BY IONS OF DEUTERIUM AND KRYPTON WITH AN ENERGY OF 5-30 kev**
M. I. Guseva 19 Nov. 1963 14 p refs Transl. into ENGLISH from Radiotekh. i Elektron. (Moscow), v. 7, no. 9, 1962 p 1680-1685
(FTD-MT-63-6/1+2+3+4; AD-428549) OTS: $1.60

The measurements of the coefficients of atomization were carried out in the chamber of an electromagnetic separator with a focusing angle of 180° C. The density of the ionic current hitting the target was 500 $\mu a/cm^2$ in the experiments with krypton and 3 to 5 $\mu a/cm^2$ in the experiments with deuterium. With an increase in the energy of the krypton ions, the coefficients of atomization of stainless steel and tantalum increase from the values 2 and 1.26 atm (tech)/ion at 5 kev to the values 4.96 and 2.97 atm(tech)/ion at 30 kev, respectively. From the experimental data, the value of the constant K in Rol's formula was determined as follows: for tantalum, $K = 0.9 \cdot 10^{-11}$ e/ev

and for stainless steel, $K = 2.47 \cdot 10^{11}$ μ/ev. An increase in the deuteron energy from 10 to 30 dev caused an insignificant increase in the coefficient of atomization of tantalum and a decrease in the coefficient of atomization of stainless steel from 0.053 to 0.020 atm (tech)/ion. R.T.K.

**N64-14385** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**ALL-UNION CONFERENCE ON ULTRASOUND**
V. M. Patskevich 25 Oct. 1963 10 p refs Transl. into ENGLISH from Khim. Prom. (Leningrad), no. 1, 1961 p 72–73
(FTD-MT-63-106/1+3+4; AD-428548) OTS: $1.10

The adoption of ultrasonic technology and progressive methods for use in industry is discussed. Included in the discussion were: the state and trend of the development of the technical application of ultrasound in machine building; the problem of the industrial use of ultrasound in chemical technological processes; the main problems in the area of production of sources of ultrasonic energy; and the development of methods and means of control, based on the use of ultrasound. It was concluded that progressive ultrasonic methods allow the solution of a number of important problems of science and production. They also promote the accomplishment of automation, increase labor production, and improve the quality of output productions. C.L.W.

**N64-14390** Argonne National Lab., Ill.
**REACTOR DEVELOPMENT PROGRAM Progress Report, December 1963**
R. M. Adams and A. Glassner 15 Jan. 1964 68 p refs
(Contract W-31-109-eng-38)
(ANL-6810)

The current status of the following areas is discussed: (1) the borax-V boiling-water reactor; (2) liquid-metal-cooled reactors that cover general fast-reactor physics, the experimental breeder-I Mark IV, the experimental breeder-II, and the FARET; (3) general reactor technology that covers applied nuclear and reactor physics, theoretical nuclear physics, reactor-fuels development, reactor-materials development, reactor-component development, heat engineering, chemical separations, and the plutonium recycle program; (4) advanced systems research and development that cover the Argonne advanced research reactor, magnetohydrodynamics, direct thermionic conversion, and regenerative emf cells; and (5) nuclear safety that covers thermal-reactor safety studies and fast-reactor safety studies. I.v.L.

**N64-14399** California U., Berkeley Lawrence Radiation Lab.
**FRACTIONAL RELEASE OF A TRACER ELEMENT THROUGH A MOVING BOUNDARY**
Stephen D. Lowe (M.S. Thesis) 30 Oct. 1963 103 p refs
(Contract W-7405-eng-48)
(UCRL-11097) OTS: $2.25

A full solution for the fractional release of a tracer element through a moving boundary has been obtained for the cases of a slab and a sphere. In both cases, the initial distribution of the tracer is assumed to be uniform throughout the body. For a constant rate of boundary motion, the full solution is valid for all times over the range from zero to complete evaporation of the body, and this solution may be applied to all finite rates of boundary motion. By applying certain limitations to the time range and to the total amount of boundary motion, the full solutions are reduced to approximate forms that are presented graphically as a family of curves. Author

**N64-14401** Brookhaven National Lab., Upton, N.Y.
**CHEMONUCLEAR FISSION FRAGMENT SOURCE AND FUEL ELEMENT DEVELOPMENT Progress Report**
Meyer Steinberg and Gerald Farber Oct. 1963 20 p refs (Supported by AEC)
(BNL-827(T-322)) OTS: $0.50

A U-Pd alloy containing up to 20 w/o $U^{235}$ has been prepared and rolled into foil of 0.1 mil thickness. The foil can be etched to a thickness on the order of 0.05 mil. The alloy shows corrosion resistance in an airstream up to a temperature of 1000° F. A 4 = in. span of 0.1-mil was found to be aerodynamically stable up to a gas velocity of 120 ft/sec. A fission fragment energy deposition efficiency of 63% was obtained with a U-Pd foil of 0.05 mil thickness. Preliminary burnup studies indicate little damage at low burnup and the importance of preventing fusion by proper cooling at high-power densities. A honeycomb assembly of thin foil seems to be the most promising structural arrangement for a practical chemonuclear fuel element. I.v.L.

**N64-14406** Atomics International, Canoga Park, Calif.
**IRRADIATION OF U-Mo BASE ALLOYS**
M. P. Johnson and W. A. Holland 30 Jan. 1964 36 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-6262) OTS: $0.50

A series of experiments was designed to assess the suitability of uranium–molybdenum alloys as high-temperature, high-burnup fuels for advanced sodium cooled reactors. Specimens with molybdenum contents between 3% and 10% were subjected to capsule irradiation tests in the Materials Testing Reactor, to burnups up to 10,000 Mwd/MTU at temperatures between 800° and 1500° F. The results indicated that molybdenum has a considerable effect in reducing the swelling due to irradiation. The amount of swelling rapidly becomes greater with increased irradiation level, and larger amounts of molybdenum are required to provide similar resistance. Small ternary additions of silicon and aluminum were shown to have a noticeable effect in reducing swelling when added to a U–3% Mo alloy base. The Advanced Sodium Cooled Reactor requires a fuel capable of being irradiated to 20,000 Mwd/MTU at temperatures up to 1500° F in metal fuel, or equivalent in ceramic fuel. It is concluded that even the highest molybdenum contents considered did not produce a fuel capable of operating satisfactorily under these conditions. Author

**N64-14408** Atomic Energy Commission, Washington, D.C. Div. of Tech. Information
**RADIOACTIVE CONTAMINATION OF THE EXTERNAL ENVIRONMENT**
V. P. Shvedov and S. I. Shirokov, eds. Oct. 1963 313 p refs Transl. into ENGLISH of the book "Radioaktivnye Zapryaneniya Vneshnei Sredy", Moscow, Gosatomizdat, 1962
(AEC-TR-6049) OTS: $4.00

The sampling methods, radiochemical, physicochemical, and physical methods of determination, identification, and measurement of the activity both of total fission products and of individual isotopes are presented in detail. Studies of the composition of artificial radioactive substances found in the external environment, and of their distribution, global fallout, and migrations are discussed. Data are also cited on a dosimetric estimation of the radioactivity of the external environment, which depends on the fission products of heavy nuclei that fall out from the atmosphere. R.T.K.

**N64-14416** California U., Berkeley Lawrence Radiation Lab.

**NEUTRON SPECTRA FROM HEAVY-ION BOMBARDMENT OF GOLD**

William G. Simon (Ph.D. Thesis) 21 Oct. 1963 82 p refs
(Contract W-7405-eng-48)
(UCRL-11088) OTS: $2.00

Neutron yields from the bombardment of a Au target by 164- and 142-Mev $O^{16}$ ions have been measured at angular intervals of 15° from 0° to 165°. Neutrons with energy from 0 to 12 Mev were detected by means of nuclear emulsions with use of the internal-radiator method. The 0°-yield measurements were extended to a neutron energy of 25 Mev by using a polyethylene radiator together with nuclear emulsions for neutron detection. The yields at 164 and 142 Mev are subtracted in order to obtain differential cross sections averaged over this energy interval, which are then transformed to the center-of-mass system. It is known that this reaction leads to fission in most cases, so that the problem of neutron-fission competition arises. The distribution of neutrons is essentially isotropic above 6 Mev. This behavior disagrees with calculations of the angular distribution of neutrons from fission fragments, which are based on measured fragment angular distributions. It is concluded that some neutrons are emitted from the system before fission occurs. Author

**N64-14419** Argonne National Lab., Ill.

**EXAMINATION OF IRRADIATED RaLa SOURCE FUEL ROD (PROTOTYPE NO. 2) FOR LOS ALAMOS SCIENTIFIC LABORATORY**

S. H. Paine, W. F. Murphy, and F. L. Brown Oct. 1963 24 p ref
(Contract W-31-109-eng-38)
(ANL-6103; supersedes ANL-5234)

A LASL fuel-bearing assembly was irradiated in the Materials Testing Reactor and subsequently examined. The design was found to be adequate for containing specimens irradiated to high burnup levels if certain defects introduced by the fabrication procedure are corrected. Author

**N64-14422** North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

**ULTRASONIC MEASUREMENT, A BIBLIOGRAPHY [1953-1962]**

[1963] 11 p refs
(SID-63-168)

**N64-14426** Iowa State U. of Science and Tech., Ames

**PRECISE MEASUREMENT OF THE K-SHELL INTERNAL CONVERSION COEFFICIENT OF THE 344-KEV, E2 TRANSITION IN $Gd^{152}$**

Guy Schupp (Ph.D. Thesis) and E. N. Hatch Aug. 1962 97 p refs
(Contract W-7405-eng-82)
(IS-590) OTS: $2.25

A value of 0.0283 ±0.0008 was obtained for the K-shell internal conversion coefficient, $\alpha_K$, of the 344-kev, E2 transition in $Gd^{152}$ using an electron-electron coincidence method. This value is relative to a value of 1.135 ±0.010 for the total internal conversion coefficient, $\alpha$, of the 122-kev, E2 transition in $Sm^{152}$. The $\alpha_K/\alpha$ ratios of 0.786 ±0.004 and 0.589 ±0.003 were measured for the 344- and 122-kev transitions, respectively. The apparent 9% discrepancy with theory for $\alpha_K$ of the 344-kev transition is not explained. The result is in excellent agreement with another measurement and also in agreement with an apparent lower trend for $\alpha_K$ of E2 transitions in near spherical nuclei. The $\alpha_K$ value for the 122-kev transition is in good agreement with theory. Author

**N64-14430** Argonne National Lab., Ill.

**TIME-OPTIMUM CONTROL OF NUCLEAR REACTORS WITH VELOCITY-LIMITED CONTROL DEVICES**

Thomas P. Mulcahey (Ph.D. Thesis—Purdue U.) Oct. 1963 127 p refs
(Contract W-31-109-eng-38)
(ANL-6695)

Since there is no single controller that will give optimum response to all reactor systems, a particular model of a reactor is established. It is based on the power system of the fast reactor EBR-II. In order to establish the method of operation of the desired controller, three main methods of analysis were used. The first involved the analytical solution of the fast-reactor kinetics equations with one group of delayed neutrons and a feedback proportional to the natural logarithm of the power. The second method involved the analog computer simulation of the six-group delayed-neutron kinetics equations with feedback. The effects of feedback delay time constants were investigated with this method. The third method consisted of the solution of the one-group and six-group delayed-neutron kinetics equations with feedback by use of a digital computer. This method was used as a measure of the range of validity of the analytical solution and as a means of improved accuracy over results obtained with the analog computer. R.T.K.

**N64-14448** Comitato Nazionale per L'Energia Nucleare, Frascati (Italy)

**SOME EXPERIMENTAL RESULTS OF SUPERCONDUCTING SOLENOIDS**

G. Pasotti, N. Sacchetti, G. Sacerdoti, and G. Sanna 11 Nov. 1963 16 p refs
(*Its* Nota interna 217; LNF-63/67)

Experimental results indicate that it is impossible, in the design stage, to predict the performance of a superconducting coil because of the difference in behavior of a piece of wire and the same wire wound in a coil. A lack of reproducibility of the performance of the coils in a given series of trials, as well as in successive trials, was found. Among the causes of nonreproducibility were the "training," local annealing of the wire caused by transitions to the normal state, residual fields, etc. It was not possible to exclude the effect of various phenomena, such as mechanical vibrations and shocks, electrical oscillation caused by the high inductance, the high stray capacitance, and the very low resistance of the circuit. Results indicate that a considerable quantity of magnetic energy is concentrated in a small volume, and that rough calculations for magnets near transition show that this stored energy is of the order of magnitude of the total energy necessary to make the superconducting electrons go into the normal state. R.T.K.

**N64-14449** Comitato Nazionale per L'Energia Nucleare, Frascati (Italy)

**STUDY OF STORAGE RING BAFFLE PLATES [STUDIO DEL DEFLETTORE DI ADONE]**

A. Massarotti, M. Puglisi and F. Tazzioli 28 Nov. 1963 34 p refs *In* ITALIAN
(*Its* Nota interna: n. 220; LNF-63/72)

The design characteristics of the deflectors or baffle plates and the injection optics for the storage ring, Adone, are discussed. Trans. by P.F.E.

**N64-14450** Comitato Nazionale per L'Energia Nucleare, Frascati (Italy)
**SYNCHRONOUS PARTICLE INJECTION AND RING OF CHARGE ACCUMULATION CAUSING RESONANCE IN THE RADIAL OSCILLATIONS OF BETATRON [PROPOSTA DI INIEZIONE NEI SINCROTRONI ED ANELLI DI ACCUMULAZIONE MEDIANTE L'INNESCO DI UNA RISONANZA NELLE OSCILLAZIONI RADIALI DI BETATRONE]**
A. Turrin 2 Dec. 1963 5 p refs in ITALIAN
(*Its* Nota interna: n. 222; LNF-63/74)

Three experiments pertaining to resonance caused by radial oscillations of a betatron are discussed. Trans. by P.F.E.

**N64-14451** Comitato Nazionale per L'Energia Nucleare, Frascati (Italy)
**INVARIANT PHASE-SPACE INTEGRAL FOR A SYSTEM OF n-PARTICLES**
G. Penso and V. Silvestrini (Rome U.) 9 Dec. 1963 9 p refs
(*Its* Nota interna 223; LNF-63/77)

The phase-space integral for a system of n-particles is expressed in terms of the integral for n−1 particles. The formula is used for the explicit calculation of the phase-space integral for 3 and 4 particles. A formula is also given for the calculation of the effective mass spectrum of k particles out of n. Author

**N64-14452** Comitato Nazionale per L'Energia Nucleare, Frascati (Italy)
**TECHNICAL ASPECTS OF THE MEASUREMENT OF IONIC CURRENTS IN LIQUID HELIUM**
I. Modena and F. Scaramuzzi 11 Dec. 1963 19 p refs
(Its Nota interna 224; LNF-63/78)

This report presents a critical survey of work in the following areas: (1) the construction of the experimental cells; (2) ion generators; (3) current detection devices; and (4) experiments involving the measurement of ionic currents in liquid helium. I.v.L.

**N64-14453** Comitato Nazionale per L'Energia Nucleare, Frascati (Italy)
**FURTHER MEASUREMENTS OF IONIC MOBILITIES IN SUPERFLUID HELIUM BY THE METHOD OF THE COMPLETE SPACE CHARGE LIMITATION**
F. Scaramuzzi 17 Dec. 1963 14 p refs
(*Its* Nota interna 225; LNF-63/79)

Measurements were made in superfluid helium of both positive and negative ions. The temperature region close to the lambda point (2.18° K) was accurately scanned for both positive and negative currents in order to precisely determine the anomalous temperature dependence of the mobility in this region. The ways in which the method of the complete space-charge limitation must be modified in order to make it into an absolute one are: an accurate calibration of the instruments measuring the current and the applied voltage, and an accurate knowledge of the distance between the electrodes. R.T.K.

**N64-14454** Comitato Nazionale per L'Energia Nucleare, Frascati (Italy)
**TEMPERATURE AND DENSITY DEPENDENCE OF IONIC MOBILITY IN LIQUID $He^3$**
P. de Magistris and I. Modena 20 Dec. 1963 13 p refs
(*Its* Nota interna 229; LNF-63/83)

The mobility of charged particles of both signs in liquid $He^3$ at various vapor pressures and temperatures was investigated. The measurements were performed at a pressure of 1 to 2 cm Hg above the vapor pressure to avoid the presence of bubbles. Results indicated that the positive ions give rise to no uncertainties, whereas the negative ions' behavior is quite different, and is, to a certain extent, arbitrary. R.T.K.

**N64-14455** Space Technology Labs., Inc., Redondo Beach, Calif.
**A STUDY OF DIFFUSION IN A CHEMICALLY FROZEN IONIZED GAS**
Stanley G. Howard Nov. 1963 51 p refs
(Rept. 9813-6005-RU000)

Heat transfer in an ionized gas is studied by comparing the results given by different diffusion models. The analysis is valid for ionized gases in which the Debye length exceeds a mean free path. Multicomponent diffusion coefficients are employed in the equations to describe exactly the heat transfer in a highly ionized gas at rest between two walls maintained at different temperatures. A simplified model is developed which is valid for weakly ionized gases, and the ambipolar diffusion model is derived when the assumption of no charge separation is made. Author

**N64-14477** Uppsala U. (Sweden)
**REMARKS IN CONNECTION WITH THE INTERNATIONAL CONFERENCE ON ATOMIC AND MOLECULAR QUANTUM MECHANICS IN HONOUR OF PROFESSOR E. A. HYLLERAAS ON SANIBEL ISLAND, JANUARY 13-19, 1963. I. THE SYMMETRY DILEMMA IN THE HARTREE-FOCK SCHEME. II. SYMMETRY PROPERTIES OF THE NATURAL SPIN ORBITALS. III. VARIATION OF THE DENSITY MATRIX**
Per-Olov Lowdin [1963] 20 p refs
(Sponsored by OAR and Wallenberg Foundation)
(*Its* Preprint 95; AD-428801)

Discussions are presented on atomic and molecular quantum mechanics. In one discussion, comments are made on some peculiarities of symmetry properties in connection with the Hartree–Fock scheme. A theorem is also discussed that states that the symmetry properties of the natural spin-orbitals are symmetry adapted. Finally, a discussion is given concerning the use of a variation of the density matrix as a mathematical tool. C.L.W.

**N64-14484** Stanford U., Calif.
**GLOBAL PROPERTIES OF MINIMAL SURFACES IN $E^3$ AND $E^n$**
Robert Osserman 1 Oct. 1963 44 p refs
(Grant DA ARO(D)31-124-G80)
(Tech. Rept. 23; AROD-1323-28; AD-428570) OTS: $4.60

A minimal surface is the surface of least area bounded by a given closed curve. In 3-dimensional space these surfaces are realized, for reasonably simple curves, by soap films spanning wire loops. This paper obtains results related to the theorem that the normals to a complete minimal surface (not a plane) are everywhere dense. The same theorem holds for two-dimensional surfaces in Euclidean spaces of arbitrary dimension $n \geq 3$. Other examples included are theorems connecting total curvature, Euler characteristic, and number of boundary components, and theorems about the normals and tangent planes to minimal surfaces, including the capacity of the set of directions omitted. Author

**N64-14501** Radio Corp. of America, Princeton, N.J. RCA Labs.
**RESEARCH ON THE VOLUME RECOMBINATION OF CESIUM IONS Final Report, 1 Oct. 1960-30 Jun. 1963**

J. M. Hammer et al Ft. Eustis, Va., Army Transportation Res. Command, Nov. 1963 31 p refs
(Contract DA-44-177-TC-694(T))
(TRECON-TR-63-73; to be used with Interim Eng. Rept. 1; AD-427812)

The feasibility of the ion-beam method of measuring the recombination cross section of cesium ions is demonstrated. Preliminary results are given. The atomic recombination cross section of $Cs_2^+$ is less than or equal to $5 \times 10^{-19}$ $cm^2$, whereas the molecular (dissociative) recombination cross section of $Cs_2^+$ is less than or equal to $3 \times 10^{-14}$ $cm^2$. The method is described briefly, and the results are presented in detail and discussed. Author

**N64-14505** Naval Research Laboratory, Washington, D.C.
**AN INVESTIGATION OF THE PHENOMENOLOGICAL CHARACTERISTICS OF (p,γ) RESONANCES [Final Report]**
R. O. Bondelid and J. W. Butler 7 May 1963 64 p refs
(NRL-5897; AD-407036)

Most of the observations were made with respect to the 992-kev resonance in the $Al^{27}(p,\gamma)Si^{28}$ reaction, but the following were also made: the 1317-kev resonance in the same reaction, the 1747-kev resonance in the $C^{13}(p,\gamma)N^{14}$ reaction, the 1424-kev resonance in the $Ni^{58}(p,\gamma)Cu^{59}$ reaction, and the 1843-kev resonance in the same reaction. The anomalies for $H_1^+$ beams are explained on the basis of fluctuations in energy loss of the bombarding protons as they penetrate the target. The theory for the anomalies observed with the use of $H_2^+$ beams is more complicated because of the larger number of parameters involved. Precise best values are given for the following narrow (p,γ) resonances: $Al^{27}(p,\gamma)Si^{28}$ reaction, 991.91 ±0.30 and 1317.19 ±0.40 Kev; $C^{13}(p,\gamma)N^{14}$ reaction, 1747.06 ±0.53 kev; $Ni^{58}(p,\gamma)Cu^{59}$ reaction, 1423.64 ±0.43 and 1843.45 ±0.56 kev. The displacement of the midpoint rise of a thick-target $H_1^+$ yield curve from the resonance energy $E_r$ as a function of the resonance width Γ is discussed. The overshoot or hump height for thick targets with $H_1^+$ beams as a function of Γ is also discussed. R.T.K.

**N64-14511** Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
**ELECTRONICS RESEARCH PROGRAM. LOW-TEMPERATURE ELECTRONICS Semiannual Technical Report, 1 Jan.-30 Jun. 1963**
F. L. Vernon, Jr. 6 Dec. 1963 23 p refs
(Contract AF 04(695)-169)
(SSD-TDR-63-311; TDR-169(3250-13)TR-1; AD-428328)

Research in low-temperature electronics has consisted primarily of measurement of the performance of critical current-critical field ($I_c$-$H_c$) characteristics of annealed niobium wire specimens. In the experiments performed, the peak effect in the $I_c$-$H_c$ characteristics occurred only for H perpendicular to the sample axis (and the current flow) and only for samples which were annealed at temperatures of 1400° C and above. For fields parallel to the current, an anomalous resistance was noticed for fields and currents well within the values which usually allow the sample to be superconducting. This "island" effect, to date, does not have a satisfactory explanation. Correlation of the field at which the peak effect occurs and the $H_{c2}$ of the Abrikosov theory show satisfactory agreement and indicate that niobium is intrinsically a superconductor of the second type. Author

**N64-14565** Los Alamos Scientific Lab., Albuquerque, N. Mex.
**ROVER REACTOR TRANSIENT ANALYSES**
W. R. Stratton and C. G. Chezem *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 155-165 refs (See N64-14551 06-01) OTS: $4.50

A report is presented on the methods used and the current capabilities for estimating the power history, fission energy release, and dynamic behavior of a Kiwi-B4 reactor when it is subjected to abnormal changes of reactivity. Conceptual accidents that are considered arise from: (1) assumed malfunction of the control vanes, (2) the lack of complete reflection (immersion in water), (3) the undermoderated character of the core (water or liquid-hydrogen flooding), and (4) the existence of void space in the core (compaction following impact on concrete or implosion within chemical propellants). A special and related case is that of the purposeful destruction of the reactor in orbit about the earth following full power operations. R.T.K.

**N64-14566** Aerojet-General Corp., Azusa, Calif.
**FLIGHT OPERATIONAL SAFETY SYSTEMS FOR NERVA**
R. I. Unger *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 167-179 (See N64-14551 06-01) OTS: $4.50

The NERVA (Nuclear Engine for Rocket Vehicle Application) engine control system incorporates interlocks and malfunction detectors and alternate or redundant controls to ensure programing and operation of the engine in a safe manner. In addition, flight safety and destruct systems complete with associated controls and actuation subsystems are required on the engine. They must function both as an anticriticality safety system and as a postoperational safety system. These systems must function upon receipt of an internal signal or a range safety command signal. The anticriticality safety systems and the postoperational safety systems are described. R.T.K.

**N64-14578** Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
**SOURCE TERM PROGRAM-AN INTEGRATED TREATMENT OF RE-ENTRY PROBLEMS**
H. I. Kraig and J. M. Bridges *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 351-360 (See N64-14551 06-01) OTS: $4.50

In order to provide an integrated calculational approach to the determination of the ground hazard from reactor fuel returning to the earth's surface, a computer program is described that will accept flight information and yield the required information on reactor fuel fragment activity as a function of time. Because the data will be used by environmental effects groups in assessing possible radiation damage, the program is called a source term program (after familiar shielding terminology). R.T.K.

**N64-14642** Battelle Memorial Inst., Columbus, Ohio
**AN INVESTIGATION OF THE EFFECTS OF SOLUTE ELEMENTS ON THE MAGNETO-ELASTIC DAMPING AND COERCIVITY IN VERY PURE IRON Summary Report**
R. E. Maringer 15 Jan. 1964 23 p refs
(Contract Nonr-2606(00))
(AD-428026)

Ferromagnetic domain walls tend to move in phase with an alternating stress or magnetic field. This movement is opposed by the presence of directionally ordered interstitial atoms. When the time associated with the relaxation process is of the order of the period of the moving walls, a phase lag between the applied field and the domain-wall movement occurs. This phase lag, coupled with normal hysteresis losses, causes the

appearance of a variety of magnetic and magnetoelastic phenomena. Among these are a strong temperature dependence of the a.c. magnetic permeability and a broad internal-friction peak in the temperature range of the Snoek peaks. These phenomena can be interpreted in terms of viscoelastic theory, with a relaxation process (interstitial directional ordering) having a unique activation energy. Author

**N64-14645** Rock Island Arsenal Lab., Ill.
**THE TORSION-EFFUSION APPARATUS FOR THE MEASUREMENT OF VAPOR PRESSURES Technical Report**
Peter Martin, Jr. 26 Nov. 1963 20 p refs
(Rept. 63-3891; AD-427821) OTS: $0.75

The Balson torsion–effusion method is based on the measurement of the recoil force developed by effusing gas. The apparatus consists of an effusion vessel suspended by a fiber in such a way that two escaping gas streams tend to twist the fiber in the same direction. The torque produced is then measured by observing the mirror-image deflection on a scale. Using this measured angle of deflection, dimensions of the holes, their distances from the axis of the suspension, and the torsional rigidity of the fiber, it is possible to calculate the vapor pressure. The advantages of the method are: (1) It gives an absolute measure of the vapor pressure. (2) Only a small amount of substance is required. (3) Knowledge of the molecular weight of the material is unnecessary in order to calculate the vapor pressure. Author

**N64-14648** Naval Research Lab., Washington, D.C.
**EXPLODING CONDUCTORS Final Report, 30 Jun. 1960–30 Jun. 1963**
W. R. Faust, G. E. Leavitt, J. D. Shipman, Jr., I. M. Vitkovitsky, and F. D. Harrington 31 Oct. 1963 21 p refs
(NRL-6009; AD-426825) OTS: $0.75

The work reported here deals with the investigation of electrically exploded wires in vacuum. The electrical pulses needed for this purpose were provided by the very low inductance capacitors. The main problems considered were: (1) the X-ray, visible, and near ultraviolet emissions from the explosions; (2) the development of the instrumentation needed to determine the time history of the current through and the voltage across the exploding wires; and (3) the relation of the current and voltage to the energy dissipated in the explosion. The techniques that were employed in the study of the various emissions are outlined. A detailed discussion of the radiation measurements in the visible range and its analysis is given. Author

**N64-14650** Bissett-Berman Corp., Santa Monica, Calif.
**ACOUSTIC NOISE CANCELLING TECHNIQUES FOR DOMED HELMETS [Final Report, 13 Mar. 1962-15 Jun. 1963]**
William B. Snow and Martin S. Tatch Wright-Patterson AFB, Ohio, AF Avionics Lab., Aug. 1963 145 p refs
(Contract AF 33(657)-8567)
(C30-31; ASD-TDR-63-855; AD-424179)

The feasibility of noise-canceling devices for producing a quiet zone within the confines of a dome-shaped space-suit helmet was studied. The conclusion from both theory and experiment was that the complex sound field inside a helmet makes it impossible to secure effective noise reduction by noise cancellation. Some alternate noise reduction methods are discussed. The tests involved construction of an artificial head with binaural pickup through microphones in the ear positions. Construction and calibration of the head are described. Author

**N64-14662** Massachusetts Inst. of Tech., Cambridge
**PROMPT ACTIVATION ANALYSIS FOR BORON AND LITHIUM Scientific Report No. 2**
Lincoln Clark, Jr. (M. S. Thesis) and Norman C. Rasmussen Oct. 1963 94 p refs
(Contract AF 19(604)-7492)
(AFCRL-63-575; AD-428201)

Activation analysis for boron and lithium is not possible in the usual sense because neither one becomes radioactive under neutron irradiation. However, both have large thermal-neutron cross sections for the $(n,\alpha)$ reaction, and activation analysis is possible if the prompt particles emitted are measured. Based on an analysis of the serveral types and sources of radiation which would be experienced, including background, it was decided to employ a gas-flow proportional counter. Neutrons for the $(n,\alpha)$ reactions were obtained for most of the work by exposure of the counter in the "hohlraum" of the MIT Reactor at a flux of $1.14 \times 10^8$ neutrons/cm$^2$-sec. The device was calibrated by use of aluminum standards containing known amounts of boron or lithium. The difference in the energy spectra makes it possible to determine the relative amounts of these two elements and, in conjunction with the count rate, to find the concentration of each in aluminum. Approximate analyses of aluminum and graphite unkowns were made in the region of one part per million boron plus lithium. Author

**N64-14671** Atomic Energy of Canada Ltd., Chalk River, Ontario Physics Div.
**PROGRESS REPORT, JULY 1 TO SEPTEMBER 30, 1963**
[1963] 83 p
(PR-P-59; AECL-1871) AEC of Canada: $2.00

The topics discussed include: (1) nuclear physics—fission studies with 14-Mev neutrons, thermal fission of $Th^{229}$, fission neutron studies, semiempirical mass formula, lifetime measurements by the Doppler-shift attenuation method, lifetimes of states in $Ne^{20}$, angular correlations from the reaction $C^{12}$ ($C^{12}$, $\alpha$)$Ne^{20}$, spin parity combination of levels in $Mg^{24}$ below 9.6 Mev excitation; (2) general physics—space physics, beta-ray spectroscopy, radioisotope standardization, and counter development; (3) neutron physics—neutron diffraction studies, normal vibrations in $\beta$-brass, lattice dynamics, gamma-ray diffraction, scattering and absorption; (4) electronics—reactor instrumentation, electronic data analyzing, automatic control and recording equipment, radiation-induced electron emission; and (5) theoretical physics—numerical methods for the many nucleon problems, neutron strength functions from inelastic neutron scattering, positive parity states in $Ne^{21}$, collective states of $Os^{190}$ and $Pt^{192}$, focusing of charged particles by an axially symmetric magnetic field, and fast neutron flux. R.T.K.

**N64-14673** Los Alamos Scientific Lab., N. Mex.
**SELECTED CONTRIBUTIONS TO HIGH PRESSURE RESEARCH FROM THE LOS ALAMOS SCIENTIFIC LABORATORY**
Barbara L. Hendry, comp. and ed. 27 Jan. 1964 32 p refs
(Contract W-7405-eng-36)
(LAMS-3011) OTS: $0.75

A bibliography of selected references on high-pressure research is presented. R.T.K.

**N64-14680** California U., Los Angeles Aerosonics Lab
**AN AEROSONICS BIBLIOGRAPHY**
Alan Powell and T. J. B. Smith Oct. 1963 116 p refs
(Contract Nonr-233(62))
(Rept. 63-51; AD-425679)

This bibliography consists mainly of references to open literature relating to those sections of acoustics that are primarily associated with fluid motion and thermal action. The contents have been brought up to date by inclusion of all available references up to May 1963. I.v.L.

**N64-14685** Tracerlab, Inc., Waltham, Mass.
**ANALYSIS OF IMPURITIES IN SOLID STATE ELECTRONIC MATERIALS Final Report**
John O'Connor 1 Oct. 1963 33 p refs
(Contract AF 19(604)-7463)
(AFCRL-63-388; AD-428785)

Use of gamma ray spectrometry greatly increases speed and flexibility of activation analyses. A detailed separation scheme is given for determination of iron, copper, phosphorous, and nickel in silicon using ion exchange. Nondestructive analysis of chromium in lasers and masers and gallium in yttrium iron garnets by activation analysis are described. Study of elution of Cu (II) from Dowex 1 resin is presented. Author

**N64-14697** Army Materials Research Agency, Watertown, Mass. Materials Research Lab.
**ANTISHIELDING OF MAGNETIC AND ELECTRIC HYPERFINE INTERACTIONS IN OPEN SHELL IONS**
A. J. Freeman and R. E. Watson (Bell Telephone Labs.) Sep. 1963 23 p refs
(Supported by AFOSR)
(AMRA TR-63-17; MRL Rept. 134; AD-425687)

In a previous paper, a new method was presented for determining, within the framework of the unrestricted Hartree–Fock formalism, the contribution of closed atomic shells (called Sternheimer antishielding) to magnetic and electric hyperfine interactions. This method is discussed and applied to the study of the antishielding of both magnetic dipole and electric quadrupole interactions associated with the aspherical valence electrons of atoms and ions. In addition to closed shell antishielding, it is shown that there are repercussions within the open shell which are significant for hyperfine interactions. Results of specific computations for the free $Fe^{2+}$ ion and the Cl atom are given, and comparisons are made with earlier perturbation theory results. Author

**N64-14708** Naval Radiological Defense Lab., San Francisco, Calif.
**DETERMINATION OF THE HALF-LIVES OF $Pm^{143}$ AND $Pm^{144}$**
L. R. Bunney and E. M. Scadden 30 Sep. 1963 16 p refs
(USNRDL-TR-684; AD-424760)

The half-life of $Pm^{143}$ has been determined as 267 ±15 d and that of $Pm^{144}$ as 349 ±16 d. Promethium-143 was produced by an $(\alpha,2n)$ reaction on $Pr^{141}$, and $Pm^{144}$ was produced by a (p,n) reaction on enriched $Nd^{144}$ (95.7%). Irradiation conditions were selected that would minimize the formation of other promethium isotopes. The decay of $Pm^{143}$ was followed on gamma-ray counters and that of $Pm^{144}$ on gamma-ray and beta-ray counters. The energies of the gamma rays emitted during the decay of these isotopes were determined from gamma-ray pulse-height distribution curves and were in agreement with the published data. Author

**N64-14709** European Atomic Energy Community, Brussels (Belgium)
**A STUDY ON THE PERFORMANCE OF NEUTRON BEAM EXPERIMENTS AT THE PULSED FAST REACTOR SORA**
R. Haas and H. B. Møller Joint Nucl. Res. Center, Ispra Estab. (Italy), Dec. 1963 64 p refs
(EUR-490.e) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 85 Belg. Fr.

The performance of pulsed neutron beam experiments is analyzed for its efficiency at a pulsed fast reactor. It is found that a double chopper and a rotating crystal spectrometer, which cover the neutron energy range from 1 mev to about 500 mev, compare well with the instrumentation that is likely to be installed at a very high flux reactor. The intensity obtained by a fast chopper is compared with that of a Lineac for kev neutron cross section measurements. General requirements for the reactor operation, reactor shielding, and the beam hole design are given. The thermal neutron flux as a function of time in a small moderator is estimated. Author

**N64-14712** California U., Berkeley Lawrence Radiation Lab.
**PURIFICATION METHODS USED FOR THE MASS-SPECTROMETRIC STUDY OF FISSION OF $U^{235}$ AND $U^{238}$ AT MODERATE ENERGIES**
Roger C. Pettersen (M. S. Thesis) Oct. 1963 26 p refs
(Contract W-7405-eng-48)
(UCRL-11074) OTS: $0.50

The sources of natural rare-earth contamination in $U_3O_8$ pressed-powder targets for cyclotron bombardments are investigated. Mass-spectrometric analysis with an enriched $Nd^{144}$ spiking solution is employed to follow the successive steps of target preparation and to check the purity of the reagents and handling materials. A solvent-extraction method for Ce(IV) is modified to remove cerium-fission products quickly and quantitatively from a bombarded target. A previously known technique is used to determine independent fractional-chain yields for the mass-135 chain for fission of $U^{238}$ and $Th^{232}$ with 60-Mev helium ions. The independent fractional yields fit a smooth gaussian curve that is somewhat broader than that for lower-energy bombardments reported elsewhere. Relative independent yields for some of the cesium isotopes and relative cumulative yields for some cerium isotopes are also reported. Author

**N64-14721** Brookhaven National Lab., Upton, N.Y.
**A REVIEW OF THE METHODS FOR COMPUTING THERMAL NEUTRON SPECTRA**
Henry C. Honeck Jun. 1963 69 p refs Presented at a spec. session of the Reactor Math. and Computation Div. of the Am. Nucl. Soc., Salt Lake City, 17–19 Jun. 1963
(BNL-821 (T-319)) OTS: $1.75

A review of the field of neutron thermalization briefly describes the techniques utilized, their relation to one another, and their applications. The emphasis is placed on those aspects which are closely related to reactor design and the numerical methods and codes that have been developed for the digital computer which is frequently used. The approximate methods for computing thermal flux distributions are classified and the applications of these methods are described. C.L.W.

**N64-14730*** National Aeronautics and Space Administration, Washington, D.C.
**ADHESION BETWEEN ATOMICALLY CLEAN SURFACES**
Douglas V. Keller, Jr. (Syracuse U. Res. Inst.) Feb. 1964 25 p refs
(NASA TN D-2228) OTS: $0.75

A broad definition of adhesion between solid metals is proposed and discussed. An interesting result of the definition is that there appears to be a real relationship between adhesion

phenomena and the processes of friction, cold welding, and sintering. A number of experimental techniques are discussed and analyzed. Author

**N64-14732** Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.

**CNCR-2-A ONE-DIMENSIONAL FEW GROUP DEPLETION CODE FOR THE IBM-7090, WHICH INCLUDES THE EFFECTS OF WATER DENSITY VARIATIONS ON NEUTRON MODERATION**

S. M. Hendley and R. A. Mangan Jan. 1964 112 p refs
(Contract AT(30-1)-3017)
(WCAP-6058)

CNCR-2, a modification of CNCR-1, solves the few-group, one-dimensional diffusion equation, in combination with a pointwise burnup calculation to determine a reactivity-lifetime relationship. Spatial variations in water density due to coolant heating are included. The modifications include a calculation of the dependence of the resonance escape probability in U-238 on the spatially varying water density, a calculation of the effect of power density on the resonance escape probability in U-238, and a water-density-dependent poison search. Author

**N64-14733*** National Aeronautics and Space Administration, Washington, D.C.

**INTERNATIONAL SYSTEM OF UNITS RESOLUTION NO. 12 [SYSTEME INTERNATIONAL D'UNITES. RESOLUTION 12.]**

Feb. 1964 5 p Transl. into ENGLISH from Comp. Rend. des Seances de la Onzieme Conf. Gen. des Poids et Mesures, Paris, 11–20 Oct. 1960 p 87–88
(NASA TT F-200) OTS: $0.50

Resolution 12 of the Eleventh General Conference on Weights and Measures adopted standards based on six basic units called the International System of Units and identified internationally by the abbreviation "SI." The basic units established are the meter for length, the kilogram for mass, the second for time, the ampere for electric current, the degree Kelvin for thermodynamic temperature, and the candle for light intensity. Nomenclature and abbreviations are also established, and derived units are included. Author

**N64-14749** European Atomic Energy Community, Brussels (Belgium)

**LOGICAL DESIGN AND CIRCUIT CHARACTERISTICS OF THE 1024 CHANNEL TIME OF FLIGHT ANALYSER BUILT IN ISPRA [CARATTERISTICHE LOGICHE E CIRCUITALI DELL 'ANALIZZATORE DI TEMPI DI VOLO A 1024 CANALI COSTRUITO IN ISPRA]**

I. De Lotto (CNR, Impresa Cibernetica CISE) and A. Termanini Joint Nucl. Res. Center, Ispra Estab. (Italy), Eng. Dept. Nov. 1963 41 p refs In ITALIAN; ENGLISH Summary
(EUR-475.I) Available from Belgian American Bank and Trust Co., N.Y., Account no. 121.86: 60 Belg. Fr.

Data handling systems for multiparameter recording are briefly reviewed. The logic diagrams are given for the whole instrument, particularly for the temporary store and for the programer of the modes of operation. The design of the most important circuits of the analog-to-digital converter, the temporary store, and the input channels are examined. Author

**N64-14753** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group

**THE ALMOST-PERIODIC SOLUTIONS AND THE DIVERGENCE OF THE LINSTEDT SERIES IN THE PLANE RESTRICTED THREE-BODY PROBLEM**

G. A. Merman [1962] 99 p Transl. into ENGLISH from Tru. Inst. Teor. Astron. (Alma-Ata), v. 8, 1960–1961 p 3–133 (MH-Transl. 412, pt. 1)

The present work has two basic purposes: to prove the existence of the almost-periodic solutions in the plane-restricted three-body problem, and to show the divergence of certain formal trigonometrical series, disposed with respect to the powers of the small parameter, for the same problem. The solutions to both of these problems follow from the existence of the set of periodic solutions with pure imaginary characteristic exponents, whose periods are multiple to the periods of the known periodic solutions of Schwarzschild. Author

**N64-14754*** National Aeronautics and Space Administration, Washington, D.C.

**MODULATION OF THE PHOTOMULTIPLIER AMPLIFICATION FACTOR IN THE MEASUREMENT OF WEAK LIGHT FLUXES [PRIMENENIYE MODULYATSII KOEFFITSIYENTA USILENIYA FOTOUMNOZHITELYA DLYA IZMERENIYA SLABYKH SVETOVYKH POTOKOV]**

N. A. Dimov Jan. 1964 5 p refs Transl. into ENGLISH by Faraday Translations from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 22, 1960 p 9–11
(NASA TT F-137) OTS: $0.50

A method, based on disturbing the distribution of interstage potentials and thus precluding zero instability, is proposed for modulating the photomultiplier amplification factor. The modulation is achieved by shorting two adjacent dynodes by a polarized relay powered from an a.c. system. This method makes it possible to replace the d.c. amplifier, with its characteristic zero drift, by an a.c. amplifier. Author

**N64-14755** Mound Lab., Miamisburg, Ohio

**MOUND LABORATORY PROGRESS REPORT FOR JANUARY, 1963**

J. F. Eichelberger, G. R. Grove, L. V. Jones, and E. A. Rembold 30 Jan. 1963 30 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1148)

Research is conducted in the areas of adhesives, isotope separation and purification, radioelements, and the development of analytical methods. Five conductive carbon blacks for use as fillers for a polyurethane adhesive are being evaluated. The lowest electrical resistivity, 2.0 ohm centimeter, is obtained by adding 35 weight percent of Continex CF carbon black as a filler to the basic adhesive formulation. The basic theory of isotope separation by thermal diffusion and other applicable techniques is being studied. Basic and applied research on a number of radioelements is being conducted to determine the physical properties, to develop analytical techniques, and to study the basic radiochemistry involved. Of particular interest are alpha emitters, their decay chains, their isotopes, and their chemical homologs. Radioelement studies included the half life of radium-223, uranium-234 recovery, waste-disposal research, and alpha- and neutron-source production. A variational method of applying least squares to curve fitting for analyzing calorimetry data is analyzed. C.L.W.

**N64-14756** Mound Lab., Miamisburg, Ohio

**MOUND LABORATORY PROGRESS REPORT FOR FEBRUARY, 1963**

J. F. Eichelberger, G. R. Grove, L. V. Jones, and E. A. Rembold 30 Feb. 1963 30 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1151)

Isotope separation, radioelements, and analytical methods are studied. Processes are being developed for separating the

isotopes of a number of elements including hydrogen, the noble gases, carbon, and uranium. Potential sources of supply of these materials are being evaluated. Basic and applied research on a number of radioelements is being conducted to determine the physical properties, to develop analytical techniques, and to study the basic radiochemistry involved. Of particular interest are alpha emitters, their decay chains, their isotopes, and their chemical homologs. Methods are being developed for analyzing elements and compounds in support of research programs; these methods include instrumental techniques and classical methods. C.L.W.

**N64-14757** Brookhaven National Lab., Upton, N.Y.
**MUON BIBLIOGRAPHY**
Marjorie Comstock, comp., and Leon M. Lederman Sep. 1963 23 p refs
(BNL-809(L-342)) OTS: $0.50

This bibliography covers the following topics: static properties, electromagnetic interaction, muonic atoms and molecules, muons in solids, weak interactions (decay, capture, etc.), muon structure and anomalous interaction, cosmic rays, and muon beams. R.T.K.

**N64-14760** European Atomic Energy Community, Brussels (Belgium)
**RAPID DETERMINATION OF CESIUM-137 IN RADIOACTIVE FALL-OUT BY MEANS OF AMMONIUM PHOSPHOMOLYBDATE [DETERMINATION RAPIDE DU CESIUM 137 DES RETOMBEES RADIOACTIVES AU MOYEN DE PHOSPHOMOLYBDATE D'AMMONIUM]**
E. Van Der Stricht Joint Nucl. Res. Center, Ispra Estab. (Italy), 1963 18 p refs in FRENCH; ENGLISH summary
(EUR-438.f) Available from Belgan American Bank and Trust Co., N.Y., account no. 121.86; 40 Belg. Fr.

A method, based on the utilization of thin layers of ammonium phosphomolybdate, has been developed for the measurement of cesium-137 in samples such as milk, vegetation, soils, fish, water, and radioactive dust. Cesium-137 can be obtained directly in a single operation in a form that enables B measurement to be made. The respective advantages of the B and $\gamma$ measurements are discussed, and the use of statistical methods in planning radioactivity monitoring measurements is illustrated. Author

**N64-14766** Ohio State U. Research Foundation, Columbus
**ON THE QUESTION OF ISOTOPIC PHASE SEPARATION IN SOLID $H_2$-$D_2$ MIXTURES Technical Report 10**
J. R. Gaines, E. M. de Castro, and J. G. Daunt Dec. 1963 10 p refs
(Contract N6onr-495(20))
(AD-427205)

Investigations are conducted of the possible isotopic phase separation in solid $H_2$-$D_2$ mixtures by observation of line widths and line shapes of nuclear resonance. Observation of the nuclear magnetic resonance line widths and line shapes of solid mixtures of n-$H_2$ and n-$D_2$ at 4.2° K showed the line shapes to be Gaussian and yielded the observed widths as a function of n-$H_2$ concentration. Nuclear resonance signals from protons in solid $H_2$-$D_2$ mixtures are studied above and below 10° K. The original n-$H_2$ concentrations of the mixtures studied are in the range 15% to 100%. The isotopes are mixed at room temperature in the gaseous state, liquefied at 20.4° K, solidified by pumping in a liquid bath of hydrogen, and cooled by liquid helium. No evidence for a composite resonance line is observed experimentally in the range 3° to 16.4° K. C.L.W.

**N64-14791** California U., Berkeley
**LONGITUDINAL NUCLEAR SPIN-SPIN RELAXATION**
R. L. Strombotne (Ph.D. Thesis) and E. L. Hahn [1963] 49 p refs
(Supported by NSF and ONR)
(AD-429014) OTS: $4.60

A theoretical and experimental study is made of the nuclear magnetization which appears after a sudden unidirectional step magnetic field is applied nonadiabatically to an ordered spin system which has been prepared by the process of adiabatic demagnetization. The magnetization exhibits damped oscillations about a nonvanishing equilibrium value. The oscillation frequencies correspond to the fundamental and harmonic components of Larmor frequency determined by the combined effect of local dipole and external step fields. The oscillations arise as the internally ordered dipole-dipole interaction energy exchanges with the suddenly imposed Zeeman energy reservoir. A density matrix calculation carried to second order in time-dependent perturbation theory, combined with a gaussian decay model, accounts for the observed oscillations within times comparable to the decay time. Fluorine nuclei in single $CaF_2$ crystals are studied for various crystal orientations with respect to the applied step field. Author

**N64-14799** Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.
**EXPERIMENTAL RADIATION MEASUREMENTS IN CONVENTIONAL STRUCTURES. PART II: COMPARISON OF MEASUREMENTS IN ABOVE-GROUND AND BELOW-GROUND STRUCTURES FROM SIMULATED AND ACTUAL FALLOUT RADIATION**
Z. G. Burson AEC Civil Effects Test Operations Feb. 1963 67 p refs
(CEX-59.7B) OTS: $1.50

An idealized fallout radiation field was simulated by the use of the Mobile Radiological Measuring Unit (MRMU). The unit employed a sealed radioactive $Co^{60}$ source that was pumped at a uniform speed through a long length of flexible tubing evenly distributed over the area of interest. Radiation levels at selected points inside two test structures were measured with sensitive ionization-chamber detectors. These measurements were compared with measurements taken under actual fallout conditions at an earlier time and were also compared with the theoretical calculations. Protection factors from fallout data and MRMU data at the basement structure compared roughly within a factor of 2. Comparisons between protection factors from fallout data and MRMU data at the under-ground group shelter were excellent. MRMU data and theoretical calculations also compared satisfactorily Author

**N64-14816** RAND Corp., Santa Monica, Calif.
**A NEW APPROACH TO TRANSPORT THEORY**
Bernard Shiffman Jan. 1964 38 p refs
(ARPA Order 189-61; ARPA-SD-79)
(RM-3862-ARPA; AD-429086)

A general viewpoint of one-dimensional, particle-transport processes is discussed; particle fluxes are considered abstractly as elements of a Banach space. The classical equations of transfer and the "initial-value" equations of Bellman's invariant imbedding are given in terms of this abstract viewpoint. The specific integro-differential equations describing an energy-dependent, neutron-transport process are obtained from the abstract equations. A complete mathematical definition of an abstract linear transport process is given in terms of a new axiomatic system. After several preliminary theorems are proven, the basic algebraic equations relating the "transport operators"

are derived, and the semigroup properties of these equations are indicated. These algebraic equations are then used to derive the standard differential equations describing a transport process. A generalization of the "Stokes relations" for homogeneous transport processes is also given. Author

**N64-14826** Polytechnic Inst. of Brooklyn, N.Y.
**A SUMMARY OF CURRENT RESEARCH AT THE MICROWAVE RESEARCH INSTITUTE Progress Report No. 24, 1 Apr.-30 Sep. 1963**
Ernst Weber [1963] 183 p refs
(Grant AF AFOSR-453-63)
(R-452.24-63; AD-427315) OTS: $13.00

Discussions are given that describe the progress in microwave research. The areas in which research was conducted are: electromagnetics; plasma electrophysics and electronics; solid-state and materials research; microwave circuits; network theory; and systems, communications, and control. C.L.W.

**N64-14827** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**A STUDY OF (np) AND (n, np) REACTIONS ON HEAVY ISOTOPES OF NICKEL**
A. K. Val'ter and V. Yu. Gonchar et al 19 Nov. 1963 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 26, no. 8, 1962 p 1079–1084
(FTD-MT-63-5/1+2+3+4; AD-429081) OTS: $1.60

The (np) and (n, np) reactions on heavy isotopes of nickel ($Ni^{61}$, $Ni^{62}$, $Ni^{64}$, and $Ni^{64}$) were studied. A neutron generator based on the reaction T(d, n) $He^3$ was used as the neutron source. The induced $\beta$-activity was measured by a scintillation counter with a thin CsI (T1) crystal connected to a FEU-29 photomultiplier. For measurement of half-lives and the separation of the activity being studied, a AI-100-1 multichannel analyzer was used. Data are presented on: (1) the measurement of the decay of $Co^{62}$ and $Co^{62*}$ obtained from $Ni^{62}$ after irradiation by neutrons with an energy of 14.1 Mev; and (2) the absolute values of the cross sections of the reactions. From the observed dependence of an (pn) reaction cross section, in a semilogarithmic scale, on the concentration of protons in the nucleus, it is evidenced that the pattern for an (np) reaction, as established by Levkovskiy in nuclei of light and average atomic weight, was well corroborated on all isotopes of nickel. I.v.L.

**N64-14834** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**THE ALMOST-PERIODIC SOLUTIONS AND THE DIVERGENCE OF THE LINDSTEDT SERIES IN THE PLANE RESTRICTED THREE-BODY PROBLEM**
G. A. Merman [1963] 104 p refs Transl. from Russian into ENGLISH
(MH-Transl.-412, Pt. 2)

In a presentation of theorems and proofs for almost periodic solutions and the divergence of Lindstedt and Birkhoff series, the following cases are included: the distribution of the symmetric periodic orbits of the elliptic and the hyperbolic types; the geometric theorem of Birkhoff on the existence of the second kind of periodic solutions; periodic solutions of the second kind in the neighborhood of the periodic orbits of Scharzschild; the existence of the almost-periodic solutions in the plane restricted three-body problem; and the divergence of Lindstedt and Birkhoff series in the plane three-body problem. C.L.W.

**N64-14835** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**ON ONE CASE OF THE MOTION OF A SOLID BODY NEAR A FIXED POINT IN THE NEWTONIAN FIELD OF FORCES**
V. V. Beletskii [1963] 11 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (USSR), v. 27, no. 1 1963 p 175–177
(MH-Transl.-437)

The motion of a body near a fixed point in the Newtonian field of forces is investigated. The body possesses a dynamic symmetry (A = B), and the fixed point coincides with the center of mass of the body for initial conditions such that the lateral components of the angular velocity are equal to zero ($p0 = q0 = 0$) and the longitudinal component is arbitrary ($r_0 \neq 0$). If the Newtonian field of forces did not exist, then the body would retain a constant direction of the axis of symmetry in the space. Therefore, all the effects of motion of the axis of the body for the considered example are conditioned only by the presence of the Newtonian field. The action of the Newtonian field appears in this case in a pure form, without being complicated by more general initial conditions. Author

**N64-14861*** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
**FAST RESPONSE, BLACKBODY FURNACE FOR TEMPERATURES UP TO 3000° K**
Allen J. Metzler and J. Robert Branstetter Repr. from Rev. Sci. Instr., v. 34, no. 11 Nov. 1963 p 1216–1218 refs
(NASA RP-121)

An inductively heated graphite furnace with a 3/8-in.-diam. source of blackbody radiation for pyrometer calibration is described. The furnace is fabricated from simple, easily demountable parts and may be operated at 1800° K for 6 hr with only infrequent attention; temperatures to 3000° K may be obtained for shorter periods. Source temperatures are stable and are rapidly attained. The time constant is approximately 2 1/2 min. Special atmospheres are not required for furnace operation, since graphite oxidation is minimized through furnace design. Author

**N64-14871** American Society of Civil Engineers, New York, N.Y.
**REACTOR CONTAINMENT**
Richard J. Smith, ed. AEC Div. of Tech. Inform., Nov. 1963 26 p refs
(NP-12980) OTS: $0.50

A total of 157 references pertaining to reactor containment is presented in five categories of interest: site selection and location, containment design criteria, dynamics and missile effects, structural and mechanical design, and construction and testing. Covered is the period from 1949 through 1962. Author

**N64-14875** Jackson and Moreland, Inc., Boston, Mass.
**EURATOM REACTOR FUEL MANAGEMENT PROGRAM. PART II: PHYSICS ANALYSIS Final Report**
Washington, AEC Div. of Tech. Inform., Jan. 1963 222 p refs
US-EURATOM Joint Res. and Develop. Program Work Jointly Performed by Allis-Chalmers Mfg. Co.
(Contract AF(30-1)-2875)
(NYO-9991) OTS: $3.00

A physical analysis of the effects of fuel management in the SENN reactor is summarized. As a result of the program the following conclusions were reached: (1) refueling from the outside inward with a four-zone to five-zone management

program results in the lowest unit energy costs for an assumed 8-day refueling time; (2) refueling from the inside outward with a four-zone to five-zone management program gives the second lowest unit energy cost; (3) single-batch loading and unloading results in the highest unit energy costs; (4) varying the feed enrichment from 1.25% to 4% produces the same relative results; (5) a constant feed enrichment of 1.84% with a four-zone to five-zone management program, refueling from the outside inward, produces minimum unit energy costs; refueling from inside outward or with two or three zones (under the same conditions) results in higher unit energy costs; (6) the variation of unit energy costs with fuel-feed enrichment is about 0.1 mill/kwh for an enrichment change of 0.16%; and (7) fuel management with banked control rods results in unit energy costs about 3 mills/kwh lower than can be obtained from unmanaged operation of a uniformly enriched core. P.V.E.

**N64-14881** Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
**IS THERE A DOUBLE SCATTERING OF LIGHT QUANTA? [GIBT ES EINE DOPPELSTREUUNG VON LICHTQUANTEN?]**
J. Blaton Jan. 1964 16 p refs Transl. into ENGLISH from Z. Phys., V. 69, 1931 p 835–849
(TIL/T-5424)

Basing the treatment of light dispersion phenomena on the principles of wave mechanics, it is shown that the charge and current densities of an atomic system, which is disturbed by an incident lightwave of frequency $\nu$, vibrate with a double frequency $2\nu$. A coherent scattered radiation at this double frequency is not detected. The reason for this is that, on the one hand, the dipole and quadripole moments, which, on optical grounds, could contribute to a coherent radiation scatter, disappear due to the observed quadratic effect, and, on the other hand, the light radiated with the double frequency of the still present moments is extinguished by interference and reduced to a scattered radiation appropriate to the heterogeneous nature of the medium. It is also noteworthy that, in the case of a linear polarized lightwave, the characteristic values of the undisturbed atom are split up due to the quadratic force effect brought about by the electric field of the lightwave. Author

**N64-14902*** Columbia U., Palisades, N.Y. Lamont Geological Observatory
**NONDESTRUCTIVE NEUTRON-ACTIVATION ANALYSIS OF SMALL PARTICLES Status Report, Mar.–Aug. 1963**
W. A. Cassidy [1963] 121 p refs
(NASA Grant NsG-232-62)
(NASA CR-55440) OTS: $10.10 ph, $3.83 mf

This report deals with the problem as to whether nondestructive neutron-activation analysis can be used to establish criteria for the natural or artificial origin of a given microscopic spherule. The following four types of particles were considered: (1) undoubted natural spherules; (2) spherules of unknown origin collected in plankton nets; (3) spherules from smoke and soot; and (4) welding beads. The results are compiled in the form of a catalog of spherule spectra and associated decay curves. All spherules were irradiated in the rabbit tube (a polyethylene pneumatic-tube messenger capsule) facility for 10 or 30 seconds, then counted periodically during the decay of induced radiation. In most cases only one spectrum, out of the many recorded, is given for each specimen. This spectrum is that one which shows best the features by means of which it is hoped to assign the specimen to the natural or artificial categories. Eight spectra are given of one green transparent natural spherule. I.v.L.

**N64-14906** Minneapolis-Honeywell Regulator Co., Minn. Honeywell Military Products Group
**NEW EXAMPLES OF "CAPTURE" IN THE THREE-BODY PROBLEM**
V. M. Alekseev [1962] 20 p Transl. into ENGLISH from Astron. Zh. (Moscow), v. 39, no. 4, 1962 p 724–735
(MH-Transl. 411)

The paper deals with the construction of new examples of "capture" in the problem of three material points, attracting each other in accordance with Newton's law. The applied methods are of a purely qualitative nature, and numerical integration is not used. The examples constructed are of a general nature and contain a total number of free parameters. Author

**N64-14907** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**THE ELECTRICAL CONDUCTIVITY OF SOLID OXIDE SYSTEMS. II. THE SYSTEM $ZrO_2$-CaO. ELECTRICAL CONDUCTIVITY AND TRANSPORT NUMBERS**
Z. S. Volchenkova and S. F. Pal'guyev 28 Nov. 1962 18 p refs Transl. into English from Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural'sk. Filial (Sverdlovsk), no. 1, 1960 p 119–126
(FTD-TT-62-1275/1+2+4; AD-295441)

An investigation of the structural components and ceramic properties of zirconium dioxide–calcium oxide systems showed that in the range from 10 to 40 mole percent of calcium oxide, solid solutions possessing good ceramic properties are formed at 1,500°C. The conductivity temperature dependence for samples of $ZrO_2$–CaO systems of various compositions was measured, and the conductivity activation energies were calculated. The highest conductivity (of the order of $3 \times 10^{-3}$ ohms$^{-1}$ cm$^{-1}$ at 1,000°C) was found for solid solutions containing 10 to 20 mole percent of calcium oxide. The transport numbers of the ions of solid solutions were measured, and values less than 0.01 were obtained for the transport number of the cations. Values found for the anion transport numbers were in the range 0.01 to 0.14. P.V.E.

**N64-14909** Jackson and Moreland, Inc., Boston, Mass.
**EURATOM REACTOR FUEL MANAGEMENT PROGRAM PART 1: SYNTHESIS OF RESULTS Final Report**
J. H. Crowley, W. J. O'Leary (Allis-Chalmers Mfg. Co.) et al Washington, AEC Div. of Tech. Inform., Jan. 1963 134 p refs US-EURATOM Joint Res. and Develop. Program
(Contract AT(30-1)-2875)
(NYO-9990) OTS: $2.50

The effects of single- and multiple-batch radial fuel-management programs on total plant cost were determined for the SENN dual-cycle boiling water reactor which was selected as a reference design. The effect of fuel management on power cost results from the potential of increased fuel exposure and increased power density of the reactor. Incentives for management of fuel in the reference plant were determined to be in excess of 3 mills/kwh for a four-to-five zone, out–in refueling scheme. Where several weeks' downtime (i.e. 6 to 8) are required for refueling operations, cost penalties exceed 1 mill/kwh as a result of reduced availability. Author

**N64-14913** Bureau of Mines, Amarillo, Tex. Helium Research Center
**APPLICATION OF THE BURNETT METHOD OF COMPRESSIBILITY DETERMINATIONS TO MULTIPHASE FLUID MIXTURES**
Earle S. Burnett 1963 19 p refs
(BM-RI-6267)

The conventional Burnett method is described briefly whereby multiphase compressibility data can be obtained by first determining the compressibility factor, Z, as an isothermal function of pressure alone. Starting at conditions of temperature and pressure where Z is known, the fluid is cooled at constant volume to some lower temperature at which the resulting pressure is measured, and a corresponding value of Z is obtained from a fundamental relationship between compressibility factors, pressures, and temperatures at constant volume. The isochoric treatment of the fluid, extended to still lower temperatures and along other isochors, eventually results in compressibility determinations for the whole two-phase system thus covered experimentally. Author

**N64-14915** Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
**SOME OPTICAL MODULATION AND DEMODULATION TECHNIQUES**
M. R. Wohlers Aug. 1963 25 p refs
(RN-166)

This note discusses the use of electro-optic crystals for modulation, describes some techniques which have been proposed, and proposes or reevaluates some additional schemes which appear to be promising. The approach taken is heuristic in that some devices discussed are time-varying systems, and the theory used is that of slow-time variation. Author

**N64-14916** Michigan U., Ann Arbor Coll. of Engineering
**DAMPING THEORY AND ITS APPLICATION TO THE INTERPRETATION OF SLOW NEUTRON SCATTERING EXPERIMENTS Technical Report**
A. Ziya Akcasu Jul. 1963 75 p refs
(NSF Grant G-20037)

In this work, only the scattering of slow neutrons by an anharmonic crystal is considered. However, the differential scattering-cross-section formula is first obtained for an arbitrary macroscopic medium, and then applied to a crystal. Explicit formulas for the width and the shift of the observed peaks in the energy spectrum of the inelastically scattered slow neutrons by crystals are obtained, and compared in the case of a single-phonon event to those by Maradudin and Fein. It is found that the shift formulas agree exactly at all temperatures, whereas the width formulas agree only in the zero temperature limit. The discrepancy in the width formulas at finite temperatures is discussed in terms of the concept of phonon lifetime. The application of the line shape theory to the interpretation of the optical experiments is also discussed. Author

**N64-14917** General Electric Co., Schenectady, N. Y. Research Lab.
**A 101,000 GAUSS NIOBIUM-TIN SUPERCONDUCTING SOLENOID**
D. L. Martin, M. G. Benz, C. A. Bruch, and C. H. Rosner Aug. 1963 14 p refs Submitted for Publication
(Rept. 63-RL-3397(M))

A major goal in superconductivity research has recently been achieved by the construction and operation of a niobium–tin solenoid that created a field of 101,000 gauss. A brief description of wire properties and preparation is given in addition to details of coil construction, heat treatment, and performance. Author

**N64-14922** Hanford Atomic Products Operation, Richland, Wash.
**HAZARDS SUMMARY REPORT FOR THE HANFORD PLUTONIUM CRITICAL MASS LABORATORY, SUPPLEMENT NO. 1, THE REMOTE SPLIT-TABLE MACHINE**
C. R. Richey, E. D. Clayton, R. H. Odegaarden, J. D. White, and W. A. Reardon Oct. 1963 57 p refs
(Contract AT(45-1)-1350)
(HW-66266 Suppl. 1 Rev.) OTS: $1.25

The hazards and operating limitations that will minimize the probability of a nuclear incident in critical experiments with $PuO_2$-hydrogenous compacts are presented. Potential hazards resulting from various component malfunctions and procedural errors during the course of a critical experiment with the Remote Split-Table Machine were evaluated. At least two simultaneous component malfunctions, together with an error in the fuel loading were found to be necessary to produce an excursion. The maximum calculated number of fissions in the excursion was about $6 \times 10^{16}$ R.T.K.

**N64-14925** Atomics International, Canoga Park, Calif.
**DEVELOPMENT OF TECHNIQUES FOR INPILE CAPSULE TRANSIENT HEATING EXPERIMENTS**
C. F. Bumpus, Jr., M. Silverberg, R. N. Cordy, and W. N. Briggs 30 Jan. 1964 72 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9009) OTS: $1.75

A description of the entire complex of experimental apparatus that was utilized for conducting inpile studies on void formation mechanisms in organic reactor transients is presented. Development of techniques required for the fabrication of portions of the experimental equipment is discussed. Fabrication procedures and techniques for high-temperature and high-pressure capsules, fast-response thermocouples, fuel-bearing transient heating sources, and a miniature neutron flux detector are described. A description of the instrumentation system that was assembled for transmitting and recording transient inpile data from temperature, pressure, and linear displacement transducers is presented. The apparatus and techniques used in the preparation of the inpile capsule for experimental operation are also described. Author

**N64-14933** Northrop Corp., Hawthorne, Calif. Northrop Space Labs.
**ABSORPTION CROSS SECTION OF ARGON AND METHANE IN THE 600 Å TO 200 Å REGION**
Om Prakash Rustgi 1 Sep. 1963 18 p refs
(NSL-TM-63-187)

Absorption cross sections of argon and methane have been determined over the wavelength range from 600 A to 200 A using the line emission spectrum from a high-voltage condensed-spark discharge in nitrogen as a light source. A maximum value of the cross section from argon beyond the $^2P^0_{1/2}$ edge was measured to be 36.0 mb. The oscillator strength for the transitions into the continuum has been obtained by integrating the experimental curve of the cross sections versus wave number up to $h\nu = 55$ ev and found to be 5.5. Similar work in methane resulted in a total f value of 7.6. Author

**N64-14945** European Atomic Energy Community, Brussels (Belgium)
**NEUTRON DISTRIBUTION IN A CRITICAL SLAB BY THE MULTIPLE COLLISION METHOD**
T. Asaoka, Y. Nakahara, and K. Saito Joint Nucl. Res. Center, Ispra Estab. (Italy), Reactor Phys. Dept., Appl. Math. Phys., Dec. 1963 47 p refs
(EUR 479.e) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 70 Belg. Fr.

The detailed distribution of monoenergetic neutrons in a critical slab with finite thickness is dealt with analytically

by the multiple collision method or the random walk approach. Under the assumption that the scattering of neutrons is spherically symmetric in the L system, the vector flux or the angular-space distribution of neutrons is obtained in the form of an infinite series of the spherical Bessel functions, from which the scalar flux and the net current are easily derived. This gives the discontinuity of the angular distribution at the boundary of the slab. This infinite series converges quickly, and an accurate result can be obtained readily by truncating the sum at the first few terms, especially for the thinner slabs. Author

**N64-14961** Westinghouse Electric Corp., Pittsburgh, Pa.
**RESEARCH ON STORAGE TARGETS FOR CAMERA TUBES Final Report, Jul. 1962-Sep. 1963**
A. H. Boerio Wright-Patterson AFB, Ohio, AF Avionics Lab., Jan. 1963 27 p refs
(Contract AF 33(657)-8676)
(RTD-TDR-63-4276; AD-428907)

This report describes an applied research program on secondary electron conduction (SEC) targets. The techniques used in fabricating the SEC layer, including its supporting member, are described in detail. The problems encountered in manufacturing and handling are reported, and the necessary precautions are outlined. Some of the more frequently occurring defects, such as target blemishes and "crazing," have been investigated. As a result, a satisfactory control over target quality has been achieved including processing of complete tubes. Author

**N64-14983*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THREE AND FOUR COIL SYSTEMS FOR HOMOGENEOUS MAGNETIC FIELDS**
M. E. Pittman and D. L. Weidelich Washington, NASA, Jan. 1964 20 p refs
(NASA TN D-2095) OTS: $0.50

Very homogeneous fields are needed in the magnetic testing of spacecraft. One method of obtaining such fields is to use a number of circular coils on a common axis. The parameters of the best three- and four-coil systems were obtained by setting to zero as many terms as possible in the equation for the field along the axis of the system. The parameters are presented in the form of tables and curves. Author

# 24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

**N64-14173** Aerospace Corp., El Segundo, Calif.
**ANALYTICAL SOLUTION FOR CONSTANT ENTHALPY MHD ACCELERATOR**
H. Mirels 4 Nov. 1963 16 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-270; TDR-269(4230-10)-3; AD-426253) OTS: $1.60

A closed form solution is obtained for a constant enthalpy, crossed field accelerator. The one-dimensional inviscid equations of motion are integrated, assuming that the axial variation of electrical energy addition and the area variation are specified. The accelerator is assumed to be segmented, and ion slip effects are ignored. The solution is useful for a parametric study of a hypervelocity wind tunnel which employs an MHD accelerator. Author

**N64-14199** Sylvania Electronic Systems, Waltham, Mass. Applied Research Lab.
**SLOT ANTENNA IMPEDANCE FOR PLASMA LAYERS Scientific Report No. 1**
Janis Galejs Aug. 1963 58 p refs
(Contract AF 19(628)-2410)
(AFCRL-63-393; AD-425300)

The rectangular cavity or waveguide backed slot is covered by a plasma layer of finite thickness. The longitudinal variation of the voltage across the slot is obtained from the variational solution of an integral equation. The solution for plasma layer of finite thickness is obtained from the free-space Green's function by the method of images. The fields outside the slot depend on the surface integral of the fields over the slot plane and over the surface of the plasma layer. If the thickness of the plasma layer is large compared with the wavelength, the fields on the surface of the plasma may be related to the voltage distribution along the slot by plane-wave reflection coefficients. This leads to an integral equation that is reduced to a form suitable for machine computations Author

**N64-14218** Raytheon Co., Wayland, Mass. Advanced Development Lab.
**INVESTIGATION OF MICROWAVE COUPLING AND ENERGY PARTITION AND TRANSPORT WITHIN A PLASMA, VOLUME I Final Report**
Edward Rolfe Jun. 1963 315 p refs
(Contract AF 19(604)-7339)
(AFCRL-63-199(1); AD-427693) OTS: $19.75

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1. FUNDAMENTAL CONCEPTS, TECHNIQUES, AND APPARATUS FOR THE MEASUREMENT OF GAS PROPAGATION CHARACTERISTICS AT HIGH MICROWAVE POWERS. CHAPTER 1 E. Rolfe, T. C. Athanis, C. Ferrar, R. Golub, S. P. Heims et al 308 p refs (See N64-14219 06-24)

**N64-14219** Raytheon Co., Wayland, Mass. Advanced Development Lab.
**FUNDAMENTAL CONCEPTS, TECHNIQUES, AND APPARATUS FOR THE MEASUREMENT OF GAS PROPAGATION CHARACTERISTICS AT HIGH MICROWAVE POWERS, CHAPTER 1 Scientific Report No. 2**
Edward Rolfe, T. C. Athanis, C. Ferrar, R. Golub, S. P. Heims et al *In its* Investigation of Microwave Coupling and Energy Partition and Transport within a Plasma, Vol. 1 Feb. 1963 308 p refs (See N64-14218 06-24) OTS: $19.75

This report describes the theoretical and experimental research program concerned with plasmas, particularly with the mechanisms of high-power microwave energy absorption and thermal energy transfer in a gas, the consequent heating of the un-ionized components of the gas, and the deionization and energy loss mechanisms involved. A detailed theoretical analysis of physical mechanisms governing the absorption of microwave radiation in gaseous plasmas and two different methods of treatment used in the analysis of plasma behavior are discussed. Wave propagation through a plasma-filled waveguide section and results of calculations performed are summarized. Author

**N64-14220** Raytheon Co., Wayland, Mass. Advanced Development Lab.
**INVESTIGATION OF MICROWAVE COUPLING AND ENERGY PARTITION AND TRANSPORT WITHIN A PLASMA, VOLUME 2 Final Report**

Edward Rolfe and John Kevin Silk Feb. 1963 187 p refs
(Contract AF 19(604)-7339)
(AFCRL-63-199(2); AD-421812)

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1. MEASUREMENT OF THREE-BODY ELECTRON-ION RECOMBINATION IN A DENSE PLASMA, CHAPTER 2 E. Rolfe and J. K. Silk p 2/1–53 refs (See N64-14221 06-24)

2. MEASURMENT OF DENSE PLASMA PROPAGATION PROPERTIES, ELECTRON DENSITIES AND COLLISION FREQUENCIES, AT HIGH MICROWAVE FIELD INTENSITIES, CHAPTER 3 E. Rolfe and J. K. Silk p 3/1–55 refs (See N64-14222 06-24)

3. ON ERROR ESTIMATION IN QUANTUM STATISTICS PERTURBATION THEORY, CHAPTER 4 W. A. Janos 8 p (See N64-14223 06-23)

4. AN APPROXIMATION THEORY FOR CLASSES OF LINEAR BOLTZMANN EQUATIONS WITH APPLICATIONS TO THE LORENTZ GAS CASE, CHAPTER 5 W. A. Janos 16 p refs (See N63-14156 12-21)

5. A LINEAR BOLTZMANN EQUATION ANALYSIS OF THE RUNAWAY EFFECT, CHAPTER 6 W. A. Janos 47 p refs (See N64-14224 06-24)

**N64-14221** Raytheon Co., Wayland, Mass. Advanced Development Lab.

**MEASUREMENT OF THREE-BODY ELECTRON-ION RECOMBINATION IN A DENSE PLASMA, CHAPTER 2 Scientific Report No. 3**

Edward Rolfe and John Kevin Silk *In its* Invest. of Microwave Coupling and Energy Partition and Transport within a Plasma, Vol. 2 Feb. 1963 p 2/1–53 refs (See N64-14220 06-24)

An experimental study of 3-body recombination in a dense plasma of helium with a trace addition of argon is reported. The plasma studied was generated by the interaction of high-intensity pulsed microwave radiation with a static volume of gas confined in a nonresonant waveguide cell. It was found that the recombination coefficient varies linearly with pressure from $4 \times 10^{-10}$ to $1.7 \times 10^{-8}$ $cm^3$/sec over the pressure range 100 to 800 torr. The experimental results are compared with the criteria of Gray and Kerr for distinguishing electron loss by recombination from loss by diffusion. Author

**N64-14222** Raytheon Co., Wayland, Mass. Advanced Development Lab.

**MEASUREMENT OF DENSE PLASMA PROPAGATION PROPERTIES, ELECTRON DENSITIES AND COLLISION FREQUENCIES, AT HIGH MICROWAVE FIELD INTENSITIES, CHAPTER 3 Scientific Report No. 4**

Edward Rolfe and John Kevin Silk *In its* Invest. of Microwave Coupling and Energy Partition and Transport within a Plasma, Vol. 2, Feb. 1963 p 3/1–55 refs (See N64-14220 06-24)

A series of experimental measurements are presented of the power and field reflection, transmission, and absorption coefficients of an intermediate dense pressure plasma generated by the breakdown at 100 to 700 torr pressure of helium gas with a trace addition of argon, by high-intensity microwave radiation. The plasma was confined in a specially designed nonresonant small X-band waveguide gas cell. The electron density and collision frequency of the plasma were determined from the field reflection coefficient. Substantial absorption of microwave energy in the plasma was observed. Since the concentration of argon was found to have no effect on the electron density, it was concluded that the Penning effect did not occur at these high pressures and field strengths, and that the free electrons were created by the ionization of helium. Ionization was seen to take place in less than 40 nanoseconds. Author

**N64-14224** Raytheon Co., Wayland, Mass. Advanced Development Lab.

**A LINEAR BOLTZMANN EQUATION ANALYSIS OF THE RUNAWAY EFFECT, CHAPTER 6 Scientific Report No. 7**

William A. Janos *In its* Invest. of Microwave Coupling and Energy Partition and Transport within a Plasma, Vol. 2 Feb. 1963 47 p refs Presented at the IAEA Conf. on Plasma Phys., and Controlled Nucl. Fusion Res., Salzburg, 4–9 Sep. 1961

The runaway effect may be interpreted as the achieving in time of the solution to the collisionless Boltzmann equation. Physically, it corresponds to a net gain of coherent energy per collision; hence it is an external field-induced transparency of scattering centers. This presupposes a screened potential, Thomas–Fermi or Debye type, for weakly or fully ionized gases, respectively. Mathematically, it is evident that the collision term with such cross sections becomes small for high velocities, and hence the collisionless form obtains. If closeness to runaway is assumed, a linearization of the Boltzmann equation (implicitly about the collisionless, runaway solution) is permissible. The present investigation concerns the linear Boltzmann equation. Methods of linear perturbation theory are used in expressing the solution about its initial collisionless value. Thus the expansion is in powers of a time integral over the full collision operator acting on the initial distribution, the conventional Neumann series expansion. Author

**N64-14235** Princeton U., N.J. Plasma Physics Lab.

**COMPUTATION OF THE EIGENFREQUENCIES OF NON-UNIFORM PLASMAS**

A. F. Kuckes Nov. 1963 8 p refs
(Contract AT(30-1)-1238)
(MATT-232)

A discussion is presented of the applicability of the Rayleigh–Ritz procedure to the calculation of the lowest modes of oscillation for plasmas, confined by magnetic fields, that demonstrate nonuniformity. Consideration is given to the propagation of an electromagnetic wave in a cylindrical waveguide filled with a plasma immersed in a longitudinal magnetic field. C.L.W.

**N64-14315** Air Force Systems Command, Wright-Patterson AFB, Ohio AF Aero Propulsion Lab.

**AN EXPLORATORY INVESTIGATION OF THE EFFECTS OF IONIZATION ON THE FLOW AND HEAT TRANSFER WITH A DENSE GAS Technical Report, May 1962–May 1963**

Henry R. Velkoff Nov. 1963 105 p refs
(ASD-TDR-63-842; AD-427234)

An investigation of the effects of ion motion on the pressure drop and heat transfer of a gas flowing in a channel was undertaken. Air and other gases were ionized within the channel, and an electrostatic field was applied normal to the flow direction. Increases in pressure drop and heat transfer of the order of 2 to 1 were found with the application of the field. It was also observed that the velocity profiles in the channel were greatly distorted due to the action of the field. Extensive data are presented on the variation of friction factor, velocity profile, and heat transfer with ion current. The significance of these results lies in the fact that large changes were observed when the ionization level was very low, of the order of 1 ion to $10^9$ neutrals in gas at standard conditions. Author

**N64-14328** New York U., N. Y. Courant Inst. of Mathematical Sciences

**STRUCTURE OF THE BOUNDARY LAYER IN A MAXWELLIAN PLASMA**

Martin H. Millman and James Hurley Nov. 1963 13 p
(Contract AF 19(604)-3495)
(Res. Rept. EM-193; AFCRL-63-376; AD-427797)

The problem considered here is that of the transition region separating a uniform Maxwellian plasma from its confining magnetic field. The geometry chosen is one-dimensional. The magnetic-field profile within the boundary layer is determined by the current distribution, i.e., by the paths of the ions and electrons. The paths of these particles, on the other hand, are determined by the fields in which they move. The equation of motion of the ions is treated exactly, and the electrons in the guiding center are treated by approximation. A self-consistent solution of Maxwell's equations is obtained. These results are compared with those obtained for a monoenergetic distribution and found to agree to within 10%. Author

**N64-14349** California Inst. of Tech., Pasadena, Calif. Antenna Lab.

**ON THE DOPPLER EFFECT IN A MEDIUM**

K. S. H. Lee Dec. 1963 94 p refs

(Contract AF 49(638)-1266; Grant AF-AFOSR 70-63)

(Tech. Rept. 29; AFOSR-5367; AD-426779) OTS: $8.60

The problem of calculating the frequency of the wave scattered by a body moving in a medium is formulated from field-theoretic considerations. The Doppler equation for a homogeneous dispersive medium is obtained on the basis of the fact that the frequency and the wave vector of a plane wave form a 4-vector. It is found that the solutions of the Doppler equation can be classified into two kinds. In one kind, the solutions are close to the frequency of the incident wave. In the other kind they appear near the poles of the refractive index of the medium on the $\omega$-axis. In the case of an isotropic plasma, the monochromaticity of the incident wave is shown to be preserved after the wave is scattered by a moving body. However, in the case of a magnetoactive plasma, the scattered wave contains more than one frequency for a monochromatic incident wave. Author

**N64-14374** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

**CONCERNING THE SOLUTION OF CERTAIN PROBLEMS OF MAGNETOHYDRODYNAMICS IN THE PRESENCE OF ANISTROPIC CONDUCTIVITY**

G. A. Lyubimov 19 Nov. 1963 25 p Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 26, no. 3, 1962 p 530–541

(FTD-MT-63-7/1+2+3+4; AD-428557) OTS: $2.60

From the generalized Ohm's law (with certain assumptions concerning the nature of the problem under consideration) a vector equation is obtained that describes the change in the magnetic field, and does not depend on the equations of mechanics. If the parameters of the problem do not depend on one of the coordinates, then this equation reduces to a system of two scalar equations. As an example, the problem of the effect of anisotropic conductivity on the flow of gas in a channel in crossed electric and magnetic fields is considered. Author

**N64-14380** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

**TURBULENT THEORY OF A WEAKLY NONEQUILIBRIUM RAREFIED PLASMA AND THE STRUCTURE OF SHOCK WAVES**

A. A. Galeyev and V. I. Karpman 7 Oct. 1963 22 p refs Transl. into ENGLISH from Zh. Eksperim. i Teor. Fiz. (Moscow), v. 44, no. 2, 1963 p 592–602

(FTD-MT-63-96/1+2+3+4; AD-428555) OTS: $2.60

A kinetic equation is derived for interacting waves in a weakly nonequilibrium rarefied plasma. The relation between the laminar and turbulent theories of shock waves without collisions in a strong magnetic field is discussed. An estimate of the turbulent width of shock waves is made on basis of the kinetic equation. Author

**N64-14473** Cornell U., Ithaca, N.Y. Graduate School of Aerospace Engineering

**THE DYNAMICAL EQUATIONS OF PARTIALLY IONIZED GASES**

Gary D. Brinker Sep. 1963 91 p refs

(Grant AF-AFOSR-62-201)

(AD-428797) OTS: $8.60

The dynamical equations for each component of a partially ionized monatomic gas are presented in two forms. Using a perturbed Maxwellian distribution to evaluate the collision integrals, the appropriate transfer equations for the multicomponent gas have been given. These transfer equations simplify greatly when the gas is assumed to be very lightly ionized and are reduced to the equations of a single-fluid-with-conduction model. The equations for a three-fluid model are derived. In this model, the properties of each species are defined in terms of its own motion, and not in terms of the total mass motion as in the one-fluid model. This model provides a useful physical interpretation of Joule heating effects. Author

**N64-14497** Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.

**MHD WIND TUNNEL PROGRAM, 1 JULY-30 SEPTEMBER 1963**

H. Mirels 13 Dec. 1963 22 p refs

(Contract AF 04(695)-269)

(SSD-TDR-63-317; TDR-269(4230-10)-4; AD-428327)

The basic design of a pulsed-type MHD wind tunnel using a hotshot source is outlined. The hotshot portion of the facility is being assembled. Author

**N64-14498** Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.

**MINIMUM LENGTH MHD ACCELERATOR WITH CONSTANT ENTHALPY AND MAGNETIC FIELD**

Harold Mirels, Richard R. Gold, and James F. Mullen 29 Nov. 1963 15p refs

(Contract AF 04(695)-269)

(SSD-TDR-63-338; TDR-269(4230-10)-5; AD-427665)

A closed form solution is obtained for the minimum length of a crossed field MHD accelerator with specified entrance and exit conditions. It is assumed that the enthalpy, magnetic field, and electrical conductivity are constant. The solution is valid when the joule heating per unit volume is small compared with the net local electrical power input. Author

**N64-14658** Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.

**A BASIC STUDY OF SLENDER CHANNEL ELECTROGASDYNAMICS**

B. Kahn and M. C. Gourdine Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Nov. 1963 90 p refs

(Contract AF 33(657)-10832)

(ARL-63-205; AD-427967)

The phenomenon of unipolar ionized gas flow through a slender cylindrical channel is investigated analytically and experimentally. The theory deals with models in which the length of the channel is considerably larger than the diameter. The experimental program reveals that due to deposition of ions on

the walls of the channel, the theoretically predicted electric fields cannot be produced. A new theoretical approach is then undertaken in which ions drifting to the wall are used to control the axial field. Initial experiments at supersonic velocities (Mach 2) indicate that stronger EGD interaction with a gas flow can be achieved at higher densities and velocities. The program establishes the feasibility of the slender channel concept and suggests that increased efficiencies can be obtained by producing colloidal rather than molecular ions at supersonic velocities. Author

**N64-14691** Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
**SURFACE WAVES ON PLASMA-CLAD METAL RODS**
T. Tamir and S. Palocz 10 Oct. 1963 30 p refs
(Contract AF 19(628)-2357)
(PIBMRI-1197-63; AFCRL-63-523; AD-427055)

Surface waves guided along a metal rod that is surrounded by a concentric isotropic plasma sheath are investigated for both the principal and the higher modes by employing a rigorous formulation. It is shown that all these modes exhibit a high-frequency cutoff phenomenon; the 2 first modes propagate down to d.c., whereas all the other modes possess a finite low-frequency cutoff, and thus exhibit bandpass characteristics. Backward wave propagation is shown to exist when the plasma sheath is thin; dispersion curves are calculated and compared with previous data obtained by means of quasi-static approximations, whose limitations and inaccuracies are also indicated. All results are derived for the plasma-clad rod placed either in free space or in a dielectric medium, and the dispersion features for both situations are represented in terms of universal curves. Author

**N64-14727*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**A DETECTOR-ANALYZER FOR STUDYING THE INTERPLANETARY PLASMA**
K. W. Ogilvie, N. Mc Ilwraith, H. J. Zwally, and T. D. Wilkerson (Maryland U.) Washington, NASA, Feb. 1964 15 p refs
(NASA TN D-2111) OTS: $0.50

The present instrument, 10 × 30 × 20 $cm^3$ in size, contains an electrostatic energy analyzer, a secondary-electron-scintillation detector, high-voltage supplies, and signal conditioning circuits. Laboratory work demonstrates constant response for protons having energies from 30 ev to 3 kev and a minimum detectable current corresponding to about 10 particles per sec. Progress is reported on the development of a velocity selector for separating ionic species. Author

**N64-14775** California U., Berkeley Electronics Research Lab.
**CYCLOTRON-WAVE INSTABILITIES**
B. J. Maxum (Ph.D. Thesis) 15 Jul. 1963 181 p refs
(Contract AF 19(628)-324)
(Sci. Rept. 23; Rept. 63-14; AFCRL-63-550; AD-426079) OTS: $12.60

Interactions of waves on electron streams or plasmas are studied for several geometric configurations of finite cross section in a finite magnetic field. For the case of two drifting streams, cyclotron waves act to give instabilities that are either convective (spatially growing) or nonconvective (time growing), depending upon whether the streams are drifting in the same or opposite directions. These instabilities, unlike the usual two-stream space-charge wave-interactions, exist for physically realizable unneutralized electron streams without the requirement that the streams drift in the same direction with almost equal velocities. For oppositely directed streams with equal velocities, oscillations are predicted at approximately one-half of the cyclotron frequency and were observed at the output of an experimental tube in which two concentric coaxial electron streams were allowed to interact in an evacuated drift space. Author

**N64-14777** Chicago U., Ill. Labs. for Applied Sciences
**RESEARCH OF EFFECT OF ARC FLUCTUATIONS ON SPECTROSCOPICALLY DETERMINED TEMPERATURES IN ARC PLASMAS First Quarterly Progress Report, 1 May-31 Jul. 1963**
Jay Burns [1963] 14 p refs
(Contract AF 33(657)-10856)
(LAS-SR-239-3; AD-429030) OTS: $1.60

A discussion is given that covers work devoted to the design and construction of spectroscopic apparatus for time-resolved spectroscopy and to preliminary experiments with two small laboratory arcs for use in spectroscopic studies. Detailed discussions are given of the five areas in which the work was conducted. These areas are laboratory arcs, high-speed photography, acoustical noise spectrum measurements, temperature measurements, and the construction of a large T-R spectrometer. C.L.W.

**N64-14822** Chicago U., Ill. Labs. for Applied Sciences
**RESEARCH ON EFFECTS OF ARC FLUCTUATIONS ON SPECTROSCOPICALLY DETERMINED TEMPERATURES IN ARC PLASMAS Second Quarterly Progress Report, 1 Aug.-31 Oct. 1963**
Jay Burns Nov. 1963 18 p ref
(Contract AF 33(657)-10856)
(LAS-SR-239-6; AD-429090) OTS: $1.60

Instrumentation and experimental work are conducted to characterize the three standard modes of a small laboratory arc. This characterization is done in terms of arc turbulence and fluctuations, and in terms of conventional time average spectroscopic temperatures. Included are the measurement of acoustical spectra, photographing of turbulence spectra, conventional spectroscopic measurements, and the development of instruments, needed for measurements. C.L.W.

**N64-14954** Oak Ridge Natl. Lab., Tenn.
**THERMONUCLEAR DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1963**
A. H. Snell et al 13 Feb. 1964 146 p refs
(Contract W-7405-eng-26)
(ORNL-3564) OTS: $2.25

This discussion describes progress in the field of thermonuclear physics. The following areas are ones in which successful research and investigations were conducted: DCX-1 plasma experiments; electron-cyclotron heating; plasma physics; vacuum arc research; cross-section measurements; production, acceleration, and injection of ionic and atomic beams; plasma theory and computation; magnetics and superconductivity; and vacuum systems, techniques, and materials. C.L.W.

**N64-14958** Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
**BOUNDARY LAYER FLOW OF DISSOCIATED GAS WITH ARBITRARY DISTRIBUTION OF SURFACE CATALYCITY**
S. W. Liu and P. M. Chung 21 Dec. 1963 32 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-345; TDR-269(4230-40)-4; AD-428903)

The Volterra equation was used for all the results presented in this report. The results are limited to flat plates so

that the influence of body geometry is avoided. Two sets of results are presented. The first contains examples of discontinuous change in surface catalytic efficiency. The second is that of power law variations in catalytic efficiency. With these results the general effect of arbitrary variation in surface catalytic efficiency can be inferred short of specific calculation. A computing program has been set up to which any arbitrary distribution of catalytic efficiency over various bodies can be admitted. Author

**N64-14967** Michigan U., Ann Arbor Radiation Lab.
**MICROWAVE-PLASMA COMPONENTS STUDY Quarterly Status Report No. 14, 1 Jul.-30 Sep. 1963**
Andrejs Olte and E. K. Miller Griffiss AFB, N.Y., Techniques Branch, Dec. 1963 20 p ref
(Contract AF 30(602)-2605)
(RADC-TDR-63-509; AD-298295)

An equivalent microwave circuit is proposed to exhibit the main features of the electron cyclotron resonance interaction in a waveguide. The essential part of the circuit consists of a nonreciprocal transmission line and similarly coupled resonant circuit. The experimental effort on the plasma package is discussed, and some of the experimental difficulties are reviewed. Author

# 25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

**N64-14183** Harry Diamond Labs., Washington, D.C.
**INSTRUMENTATION AND MEASUREMENTS**
R. W. Tucker, J. I. Cooperman, and R. F. Shoemaker *In* Natl. Acad. of Sci.-Natl. Res. Council Dielectrics Dig. of Lit., Vol. 26, 1962 1963 p 1-6 (See N64-14182 06-01)

An annotated bibliography is presented that includes information on: (1) books on instrumentation; (2) measurements below 100 mc—standards, d.c. methods, and a.c. methods; and (3) measurements above 100 mc—resonance methods, waveguide methods, and miscellaneous apparatus and techniques. R.T.K.

**N64-14186** Naval Research Lab., Washington, D.C.
**CONDUCTION IN SOLID DIELECTRICS**
J. W. Davisson and J. Pasternak *In* Natl. Acad. of Sci.-Natl. Res. Council Dielectrics Dig. of Lit., Vol. 26, 1962 1963 p 117-156 refs (See N64-14182 06-01)

The following are included in this annotated bibliography: (1) reports of meetings and books; (2) ordinary conduction—theoretical, halides, sulphides and arsenides, oxides, glass, other inorganic materials, and organic materials; and (3) photoconduction—theoretical, halides, sulphides, other inorganic materials, and organic materials. R.T.K.

**N64-14188** Clevite Corp., Cleveland, Ohio Electronic Research Div.
**FERROELECTRIC AND PIEZOELECTRIC MATERIALS**
William R. Cook, Jr. *In* Natl. Acad. of Sci.-Natl. Res. Council Dielectrics Dig. of Lit., Vol. 26, 1962 1963 p 187-227 refs (See N64-14182 06-01)

Information on the following is presented in this annotated bibliography: (1) general reviews and books; (2) theory and mathematics; (3) techniques; (4) laser experiments; (5) applications; (6) miscellaneous refrences; (7) $BaTiO_3$—crystal structure and preparative techniques, domains, hysteresis, switching, surface layer, electrical properties, and additives; (8) other perovskite materials; (9) other oxides; (10) sphalerite-wurtzite oxides and sulfides; (11) quartz and other silicates; (12) tartates; (13) phosphates and arsenates; (14) sulfates, selenates, and fluoberyllates—triglycine sulfate and isomophs, guanidine aluminum sulfate hexahydrate group, other sulfates, etc.; (15) sodium nitrite and potassium nitrate; and (16) other crystals. R.T.K.

**N64-14280*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE TRANSPORT PROPERTIES OF P-TYPE PbTe**
Martin M. Sokoloski and John H. Marburger III (Stanford U.) Nov. 1963 42 p refs
(NASA TM X-51388; X-633-63-233) OTS: $4.60 ph, $1.46 mf

Nearly all the elementary parameters that appear in the theoretical expressions for mobility can be determined from measurements of transport properties. Measurements of the Hall coefficient give information on the number of charge carriers, the one parameter most likely to vary from sample to sample. Measurements of the conductivity and thermoelectric power give information about the mobility and Fermi level. These measurements provide the basis for quantitative theoretical predictions. This paper discusses how these predictions are made, modifications of the instrumentation, results, and accuracy of the results obtained by this method. E.W

**N64-14295** Ion Physics Corp., Burlington, Mass.
**P-N JUNCTION FORMATION TECHNIQUES Third Quarterly Report [Final] 20 May-1 Sep. 1963**
W. J. King et al Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Nov. 1963 55 p refs
(Contract AF 33(657)-10505)
(RTD-TDR-63-4125; AD-427178)

Investigations were continued on spectral response as a function of junction depth in p-on-n-type cells. A further "blue" shift was observed with lower implantation energy (100 Kev), the equal photon relative response curve peaking at 6000 A. Graphically determined values of minority carrier diffusion lengths in the surface region show a trend towards values equaling junction depth for low-energy implanted cells. Base diffusion lengths ($\sim 40\mu$) indicate a need for better starting material to obtain more efficient cells. An empirical curve has been obtained which gives the relative efficiencies under solar and tungsten light (140 mw/cm$^2$ incident) as a function of implantation energy. This curve shows good agreement with values predicted from spectral response curves. Author

**N64-14316** Air Force Systems Command, Wright-Patterson AFB, Ohio
**RING LASER TECHNIQUES FOR ANGULAR ROTATION SENSING**
D. A. Guidice and W. L. Harmon Sep. 1963 43 p refs Presented at the ASD Sci. and Eng. Symp., Wright-Patterson AFB, Ohio, Sep. 18-19, 1963
(ASD-TDR-63-694; AD-425706)

The optical frequencies of the clockwise and the counterclockwise beams traveling around the perimeter of the square "ring" depend on their respective optical path lengths which are equal in the absence of rotation. However, angular rotation alters the path lengths, resulting in different frequencies for the

two traveling waves. The two waves are optically heterodyned in a photodetector, and the resultant beat frequency is directly proportional to the rotation rate of the "ring." An experiment verifying the existence of this phenomenon using a gas laser in the square "ring" configuration is given. The physics of mode pulling and various ways to minimize or bypass this problem are discussed in detail. Techniques for artificially separating the frequencies of the two waves by introduction of nonreciprocal elements into the optical path are described. Accuracy limitations caused by mechanical instabilities, excitation variations, and inherent stimulated emission line width are examined. Author

**N64-14325** Army Signal Research and Development Lab., Fort Monmouth, N.J.

**MAXIMUM GAIN FOR FORWARD AND BACKWARD WAVE OPTICAL MASER AMPLIFIERS**

H. Jacobs, D. A. Holmes, L. Hatkin, and F. A. Brand Jul. 1963 30 p refs

(USAELRDL-TR-2375; AD-418338)

An analysis has been made of the mechanism of amplification in a device consisting of three media. The first medium is considered to be air, the second medium to be a crystal having a specific dielectric constant and distributed negative conductivity of constant value, and the third medium air. The equations for power gain in transmission and reflection are derived in a general manner. Following this, the condition on the length of the active region for maximum power gain in both forward and reflected modes of operation, as well as the magnitude of gain, is approximated. When the development is applied to the ruby optical maser, the length-producing maximum gain is found to be the same for both the reflection- and transmission-type amplifier. Furthermore, as the length of the crystal is increased, oscillations are predicted at a single optimum value of the product of the negative attenuation constant and length. Author

**N64-14354** Michigan U., Ann Arbor Electron Physics Lab.

**TRAVELING-WAVE MASER EXPERIMENTS USING RUBY AT X-BAND**

G. I. Haddad and D. H. Paxman Nov. 1963 34 p refs

(Contract AF 33(657)-8050)

(Tech. Rept. 63; 05000-9-T; AD-425569) OTS: $4.50

The characteristics of a traveling-wave maser using ruby and a Karp-type slow-wave structure in the X-band frequency range are presented. Several possible operating points in ruby in this frequency range were examined, and the inversion ratio, paramagnetic absorption, and electronic gain at these points were measured. The experimental results are compared with the theoretical predictions. The problems involved in the design of the traveling-wave maser are discussed, and the performance that may be expected of a maser using good ruby crystals, a well-matched structure, and sufficient pump power is evaluated. Author

**N64-14377** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

**THE EFFECT OF GAMMA RAYS ON GERMANIUM DIODES**

Ye. M. Lobanov, V. I. Zvyagin, D. I. Blinkov, and G. B. Blinkova 8 Oct. 1963 7 p refs Transl. into ENGLISH from Nekotoryye Vopr. Prikl. Fiziki (Tashkent), 1961 p 55–57

(FTD-MT-63-88/1+2+3+4; AD-428551) OTS: $1.10

Investigations were conducted of the negative photodiode effect of germanium diodes exposed to irradiation by gamma rays. It was assumed that the negative photodiode effect was connected basically with disturbances in volume. It was discovered that, during irradiation of germanium diodes with gamma rays, a sharp change of the characteristics of the diodes occurs because of distrubance in the crystal grid in the volume, and because of the rebuilding of a layer of germanium dioxide in the monoxide film which forms on the surface of the germanium. C.L.W.

**N64-14383** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

**INVESTIGATION OF OPTICAL OSCILLATOR ON RUBY AT LIQUID NITROGEN TEMPERATURE**

V. K. Konyukhov, L. A. Kulevskiy and A. M. Prokhorov 21 Oct. 1963 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 149, no. 3, 1963 p 571–572

(FTD-MT-63-100/1+2+3+4; AD-428544) OTS: $1.10

Characteristics of spectral components of radiation from a ruby laser operating at T = 77.4° K are given. At nitrogen and helium temperatures, the spectrum of an optical oscillator on ruby consists of two components corresponding to transition from metastable level to sublevels $\pm 1/2$ and $\pm 3/2$ the basic state. E.W.

**N64-14386** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

**DIFFUSION OF TANTALUM IN SINGLE-CRYSTAL GERMANIUM**

V. I. Tagirov and A. A. Kuliyev 7 Oct. 1963 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Mat. I Tekhn. Nauk (Baku), no. 1, 1962 p 65–68

(FTD-MT-63-107/1+2+3+4; AD-428546) OTS: $1.10

The experiments were conducted in a temperature range of 750° to 900° C and 800° to 900° C on samples having a specific resistance of 10 and 45 ohm/cm, correspondingly. The determination of the diffusion coefficient was conducted by the method of removal of films with the application of a radioactive isotope, $Ta^{182}$, with a half-life of 111.2 days. The dependence of the diffusion coefficient on the reverse temperature is presented graphically. The pre-exponential multiplier and the activation energy are greater for samples with large specific resistance, as can be noted from the temperature dependence of the diffusion coeficient of tantalum in germanium. The value of the activation energy obtained at 60 ohm/cm by Sandulova and He yii-liang, in the limit of an error of the experiment, is well coordinated with the value obtained for germanium with a specific resistance of 45 ohm/cm. At the same time the values of the diffusion coefficient differ, which, obviously, is connected with the different perfection of single-crystal germanium. I.v.L.

**N64-14397** Michigan U., Ann Arbor Inst. of Science and Tech.

**LUMINESCENCE OF MANGANESE-ACTIVATED MAGNESIUM GERMANATE**

Richard A. Phillips Jan. 1964 8 p refs

(Contract DA-36-039-SC-78801; Proj. Michigan)

(Rept. 2900-446-R)

The emission spectrum of $Mg_4GeO_6$:0.01 Mn has been found to depend on the temperature of preparation. The spectrum of the sample prepared at 1,275° C shows four narrow bands at 6,200 A to 6,600 A; the spectrum of the sample prepared at 1,475° C consists of a broad band centered at 6,150 A. X-ray diffraction patterns of the powders indicate the presence of an intermediate phase in the sample prepared at 1,275° C. It was concluded that the valence of the manganese activator is different in the two samples. Author

**N64-14398** California U., Berkeley Lawrence Radiation Lab.
**THE FORMATION OF POROSITY DURING DIFFUSION PROCESSES IN METALS**
Dennis M. Maher (M.S. Thesis) Sep. 1962 74 p refs
(Contract W-7405-eng-48)
(UCRL-10383) OTS: $1.75

Evidence is presented which indicates that the porosity formed during diffusion processes in Cu–Ni and Ag–Au couples is heterogeneously nucleated in the presence of a relative excess concentration of vacancies resulting from the unequal mass flow of the two participating constituents. The nature and extent of porosity is dependent on the purity of the sample and thus appears to be related to the number or "potency" of nuclei available for vacancy agglomeration. From metallographic observations on the distribution of porosity, it is estimated that pores will form when vacancies are pumped into any small region of the diffusion zone at the rate of about $10^{15}$/cm$^3$/sec in oxygen-free high-conductivity copper and $10^{17}$/cm$^3$/sec in spectroscopically pure copper. Author

**N64-14400** California U., Berkeley Lawrence Radiation Lab.
**DIFFUSION OF IRON INTO SODIUM DISILICATE GLASS**
Marcus P. Borom (M.S. Thesis) 12 Nov. 1963 44 p refs
(Contract W-7405-eng-48)
(UCRL-11116) OTS: $1.00

Diffusion couples of elemental iron and degassed sodium disilicate glass rod were prepared under neutral to reducing conditions at several temperatures and at varying times. The diffusion profiles were analyzed by using electron microprobe techniques. Diffusion-coefficient calculations and activation-energy determinations indicated that a change in mechanism was occurring between 1000° and 1050° C. An indication is given by the magnetic-susceptibility measurements that atomic iron is the diffusing species at 900° C and that ferrous iron is the diffusing species at 1050° C. These observations are supported by transmission-spectroscopy measurements and by theoretical thermodynamic considerations. A discussion of the possible mathematics of the diffusional processes is given. Author

**N64-14464** Leicester U. (Gt. Brit.)
**INVESTIGATION OF CHARGE TRANSPORT AND CARRIER GENERATION IN CdS Quarterly Technical Status Report No. 11, 1 Mar. 1963-31 May 1963**
Walter Eric Spear [1963] 5 p
(Contract DA-91-591-EUC-2735)
(E-745-P; AD-428395)

An interesting correlation was found between the electron transport in CdS and the green luminescence (edge emission) that is observed when some of the crystals are excited by UV radiation. The results of this work appear to provide fairly conclusive evidence in favor of the Lambe–Klick Model, one of the two diametrically opposite models that have been proposed to explain the green luminescence. Research during the last 3 months was mainly concentrated on providing further evidence in this direction, and also on correlating the present results with more detailed optical data from the same crystals. Author

**N64-14472** Uppsala U. (Sweden)
**JAHN-TELLER EFFECT AND VALENCE BOND METHOD**
Ernest M. Loebl Sep. 1, 1963 9 p refs
(Sponsored by Knut and Alice Wallenberg's Foundation and Aeron. Res. Labs., OAR, USAF)
(Preprint 106; AD-428802)

The application of the valence bond method to the Jahn-Teller effect is examined from a group-theoretic point of view; the conditions under which the additional modes of instability described by Birman will appear are discussed. Author

**N64-14482** Michigan U. Ann Arbor Inst. of Science and Tech.
**TELLURIUM CRYSTAL GROWTH**
R. C. Keezer Dec. 1963 31 p refs
(Contract DA-36-039-SC-78801; Proj. Michigan)
(Memo. No. 2900-435-R; AD-428016)

Techniques employed for the preparation of single crystal tellurium by the slow-cooling, vapor, Bridgman, and Czochralski methods are described; the last method is emphasized. The Czochralski method has provided large (17 mm diameter by 70 mm long) single crystal boules, and lends itself to the addition of dopants during crystal growth. The ready cleavage parallel to the c axis evidenced by tellurium crystals requires the use of special techniques for fabrication of samples for optical and electrical evaluation. Author

**N64-14490** Case Inst. of Tech., Cleveland, Ohio
**PRESSURE DERIVATIVES OF THE SINGLE CRYSTAL ELASTIC CONSTANTS OF POTASSIUM Technical Report No. 7**
Paulen A. Smith (Ph.D. Thesis) Dec. 1963 39 p refs
(Contract Nonr-1141(05))
(AD-427837)

The elastic stiffness constants of single-crystal potassium and their pressure derivatives have been measured at room temperature by the ultrasonic pulse-echo method. The values found are: $C = 1.88$, $C' = 0.281$, $B_s = 3.34$ (units of $10^{10}$ dynes cm$^{-2}$), $dC/dP = 1.62$, $dC'/dP = 0.251$, $dB_s/dP = 3.97$ The notation

$$C = C_{44},\ C' = (C_{11} - C_{12})/2,\ B_s = (C_{11} + 2C_{12})/3$$

has been used. The results have been interpreted in terms of Fuchs' theory of the electrostatic contribution to the shear stiffnesses of the alkali metals. The experimental observation that the elastic anisotropy, $C/C'$, does not depend on pressure indicates that, as Daniels found for sodium, it is not necessary to include an ion core interaction or a Fermi contribution to the shear stiffnesses in order to account for the results. Author

**N64-14494** Philco Corp., Blue Bell, Pa. Sci. Lab.
**COHERENT OPTICAL BEAM STEERING TECHNIQUES Final Report, 27 Dec. 1962-15 Sep. 1963**
Leo W. Procopio, Frederic A. Jessen, Peter M. Nave, and Lewis J. Brown Griffiss AFB, N.Y., Tech. Branch, Jan. 1964 113 p refs
(Contract AF 30(602)-2901)
(RADC-TDR-63-450, Vol. 1; AD-428203)

The technical problems involved in achieving an electronically scanned, coherent, optical phased array are examined in detail. Background information pertinent to an array design, including studies of coherent optical components, optical losses, limitations imposed by propagation effects, and radiation patterns generated by laser elements is presented. Techniques to achieve both electronic steering of a single laser beam and a phased array of lasers are analyzed. Studies include consideration of the physical devices themselves, and analysis of their environmental sensitivity, radiation characteristics, and response speeds. Design investigation of the optical phased array includes analysis of the laser oscillator-amplifier combination, the electronically controlled optical

phase shifters, the element beam steering devices, and the output telescope systems. Typical design data and performance specifications are presented. Author

**N64-14495** Philco Corp., Blue Bell, Pa. Sci. Lab.
**COHERENT OPTICAL BEAM STEERING TECHNIQUES Final Report, 27 Dec. 1962-15 Sep. 1963**
Leo W. Procopio, Frederic A. Jessen, Peter M. Nave, and Lewis J. Brown Griffiss AFB, N.Y., Tech. Branch, Jan. 1964 212 p refs
(Contract AF 30(602)-2901)
(RADC-TDR-63-450, Vol. 2; AD-428670)

The present state-of-the-art in coherent optical-signal generation is summarized. Generation, amplification, and modulation of coherent light is covered, along with optical-beam switching, power losses in optical components, propagation effects on coherent light, the far-field pattern of an array of lasers, laser-beam steering techniques, angular magnification techniques, and environmental sensitivity of optical components. C.L.W.

**N64-14506** Stanford Research Inst., Menlo Park, Calif.
**INVESTIGATION OF CRYSTAL GROWTH PROCESSES Final Report**
W. J. Fredericks, F. E. Rosztoczy, and J. Hatchett 15 Jan. 1963 31 p refs
(Contract AF 49(638)-999)
(AD-407600) OTS: $3.60

A method for purification of KCl by anion and cation exchange has been developed. The crystalline product of the purification process and single crystals grown from this product were evaluated. Optical data indicate the $OH^-$, $Br^-$, and $I^-$ concentration has been reduced. Emission spectroscopy indicates the $Na^+$ content has been significantly reduced. Electrical conductivity measurements indicate that the divalent-ion concentration is comparable to that of 10-pass zone-refined material if compensation does not occur. An attempt was made to grow crystals from an $H_2S$ solvent at high temperatures and pressures. To date these results have not met with success, but measurements of solubility show that it is a possible method for growing CdS and ZnS. Author

**N64-14849** Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.
**APPLIED RESEARCH PROGRAM ON HIGH TEMPERATURE RADIATION RESISTANT SOLAR CELL ARRAY, VOLUME II [Final Report, 15 Apr.-14 Oct. 1963]**
Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab. Dec. 1963 68 p refs
(Contract AF 33(657)-8490, SAI)
(AED-R-2117; ASD-TDR-63-516, Vol. 2; AD-428634)

The overall objective of the program is the development of the technology necessary for the production of a high-temperature radiation-resistant solar-cell array in a configuration suitable to aerospace vehicles. This project includes (1) determination of the mechanical, thermal, optical, and electrical parameters of gallium arsenide cells, individually and as part of a panel; (2) evaluation of the performance of GaAs cells under the conditions of nuclear radiation encountered in an orbital environment, as compared with silicon and cadmium sulfide cells in similar environments; (3) a feasibility study of thin-film GaAs; and (4) a document summarizing the work and containing recommendations for further research and development in this area. Author

**N64-14667** Radio Corp. of America, Camden, N.J.
**DOPPLER OPTICAL NAVIGATOR Second Quarterly Progress Report, 6 Sep.-6 Dec. 1963**
W. J. Hannan, L. J. Nicastro, G. Clubine, and T. E. Penn 19 Dec. 1963 92 p refs
(Contract AF 33(657)-11458)
(AD-426411)

The objective of this program is to determine the feasibility of novel laser techniques for Doppler optical navigation. The performance goal is the measurement of ground speed with 5 m/sec accuracy at a maximum altitude of 300 miles. Analysis and experimental results indicate that amplitude modulation can be used to improve the coherence of the return signal. At optical frequencies the ground is a diffuse reflector, whereas at a subcarrier frequency (or amplitude modulation frequency) it is not. As a result, a higher signal-to-noise ratio is realized with an amplitude-modulated wave, enabling velocity to be measured more accurately. An analysis of various filtering techniques showed that a subcarrier heterodyne receiver with a phase-locked oscillator filter will provide the best performance. Further, this analysis showed that optical heterodyne techniques will not improve the performance of the receiver. Author

**N64-14677** Sperry Gyroscope Co., Great Neck, N.Y.
**ELECTROMAGNETIC ANGULAR ROTATION SERIES Interim Engineering Report No. 2, 1 Sep.-15 Nov. 1963**
W. Macek, D. Davis, R. Schneider, R. Salamon, R. Kroeger et al Nov. 1963 38 p ref
(Contract AF 33(657)-11433)
(AB-1108-0016-2; AD-426349)

Ring-laser biasing studies are being conducted using a solid, as well as a liquid and gaseous, Fizeau effect. Primary emphasis is still being devoted to the Faraday technique using retardation plates coupled with a solid and liquid medium. The 4-m and 80-cm ring lasers (1.153 $\mu$) are still in operation, with the former primarily used for the biasing studies and the latter for stability measurements. Based on the successful 3- and 4-m visible ring lasers, and 8-m visible ring has been built and is operating. This ring is designed to be tilted (rather than having its support rotate) so as to vary the component of the earth's rotation rate. A new technique for sensing rotation direction without recourse to biasing has been demonstrated. Author

**N64-14684** Illinois U., Urbana Gaseous Electronics Lab.
**SCATTERING OF RUBY LASER LIGHT BY GASES Scientific report No. 5 [Final]**
T. V. George and L. Goldstein Oct. 1963 102 p
(Contract AF 19(604)-7473)
(AFCRL-63-549; AD-427730)

In the present experiment, the angular distribution of the light scattered by gas molecules was measured from 45° to 135° from the direction of the incident beam in argon at 1 atm and xenon at 135 mm Hg of pressure. Experimental results show partial agreement with the Rayleigh theory. The lack of agreement is perhaps due to coherence effects. In argon, the scattered intensity shows a linear pressure dependence. No dependence of scattering cross section on the beam power level was found in either monatomic or polyatomic gases. The differential scattering cross section at an angle of 60° with the beam was determined for various gases and compared with that calculated from known values of refractive indices. An empirical analysis of the discrepancy between the experimental observation and Rayleigh theory is also presented. Author

**N64-14690** Army Materials Research Agency, Watertown, Mass. Materials Research Lab.
**A STUDY OF THE CRYSTAL DYNAMICS OF ZINC**
J. J. Antal, G. Borgonovi, and G. Caglioti (Euratom, Ispra) Sep. 1963 18 p refs
(AMRA TR-63-19; MRL Rept. 138; AD-425686)

A number of the normal modes of vibration of the anisotropic, hexagonal metallic system of zinc have been studied through a determination of the dispersion relations by neutron inelastic scattering. Measurements carrying relatively small experimental errors have been made for directions in a single crystal that produce information about the motions of atoms within the basal planes, the motion of the basal planes acting as single units, and the motions of atoms perpendicular to the basal planes that tend to warp these planes. Attempts are made to fit the experimental data to formulations of Born–Von Karman dynamical theory involving generalized forces between pairs of atoms. Consideration of forces extending to fourth-nearest neighbors is necessary to obtain agreement with our dispersion relations. Author

**N64-14705** Franklin Inst., Philadelphia, Pa. Labs. for Research and Develop.
**DIFFUSION IN ORGANIC CRYSTALS Quarterly Technical Report, 1 Oct.-31 Dec. 1963**
C. H. Lee, P. J. Reucroft, H. K. Kevorkian, and M. M. Labes [1964] 7 p
(Contract DA-31-124-ARO(D)-142; ARPA Order 462)
(B2130-T-2; AD-427160)

This report describes improvements on basic experimental techniques, and presents preliminary data on the directional dependence of the self-diffusion coefficient for anthracene. Author

**N64-14874** Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
**THE ANALYSIS OF LASER OPERATION FROM A MICROWAVE CIRCUIT VIEW POINT**
M. R. Wohlers Jul. 1963 15 p refs
(RN-163)

The linear microwave-circuit theory of lasers is developed by ascribing the microscopic parameters $\mu$, and $\epsilon$ to lasing materials and then obtaining solutions to Maxwell's equations in the regions of interest. The approach is applied to a plane-wave Fabry–Perot interferometer filled with lasing material, and the threshold conditions for lasing or oscillation are determined. An example is presented which demonstrates the results as applied to a typical He–Ne laser. Author

**N64-14895*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**MASERS**
W. H. Higa 26 Jul. 1962 21 p refs
(NASA Contract NAS7-100)
(NASA CR-53044; JPL-TM-33-95) OTS: $2.60 ph, $0.83 mf

The following discussion of masers is intended primarily for the electronics engineer interested in a quick introduction to the subject. After a concise review of the physics of induced radiative emission by atoms, a fairly complete discussion of use of atoms as circuit elements is given. The concluding sections describe the actual application of masers to sensitive receiving systems. Author

# 26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

**N64-14201** Union Carbide Corp., Oak Ridge, Tenn. Reactor Chemistry Div.
**SELF-DIFFUSION OF BERYLLIUM IN UNIRRADIATED, COLD-PRESSED AND SINTERED BERYLLIUM OXIDE**
H. J. de Bruin and G. M. Watson 29 Jan. 1964 39 p refs
(Contract W-7405-eng-26)
(ORNL-3526) OTS: $0.75

For the polycrystalline cold-pressed and sintered BeO studied, the diffusion behavior between 1150° and 1800° C is described by the empirical relation:

$$D = 2.49 \times 10^{-3} \exp\left(-\frac{62.5 \times 10^3}{RT}\right) \text{ cm}^2/\text{sec.}$$

A diffusion model is proposed based on vacancy migration which suggests indentical activation energies for diffusion in both *a* and *c* directions in single crystals and predicts an activation energy of the correct order of magnitude. Furthermore, the model predicts that the frequency factor in the direction perpendicular to the *c* axis should be about 50 percent higher than that parallel to the *c* axis. Author

**N64-14323** Michigan U., Ann Arbor Aircraft Propulsion Lab.
**THE INFLUENCE OF A COMPRESSIBLE BOUNDARY ON THE PROPAGATION OF GASEOUS DETONATIONS Technical Report**
E. K. Dabora (Ph.D. Thesis) Dec. 1963 156 p refs
(Grant DA-ARO(D)-31-124-G-345)
(AROD-3559-1; Rept. 05170-1-T; AD-427007)

The theoretical analysis presented in this work shows that a detonation wave in a gaseous explosive bounded by an inert gaseous medium propagates at a lower velocity than it would if the explosive were inside a tube with a solid wall. The velocity decrement is found to be dependent primarily on the ratio of the initial densities of the explosive and the inert gases, the reaction length of the explosive, and the extent of the explosive normal to the interface. Extensive experimental results on $H_2$–$O_2$ mixtures bounded by nitrogen and some results on stoichiometric $CH_4$–$O_2$ bounded by different gases show a general agreement with theory. Other results relative to the behavior of the detonation wave when the explosive is much denser than the boundary gas and also near the quenching limit are included. It is concluded that the experimental method described can be used as a new tool for determining some important properties of gaseous detonations. Author

**N64-14384** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**INFLAMMATION OF METHANE MIXTURES IN SHOCK WAVES**
A. A. Borisov, S. M. Kogarko, and A. V. Lyubimov 23 Sep. 1963 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 149, no. 4, 1963 p 869–871
(FTD-MT-63-101/1+2+3+4; AD-428545) OTS: $1.10

Flammability of methane mixtures with oxygen and different inert diluents was studied for the purpose of ascertaining the dependence of delays of ignition on pressure and concentration of the components. A comparison of delays in ignition

of mixtures diluted by nitrogen and argon shows that the mixtures diluted by nitrogen have smaller delays in ignition. In mixtures with a surplus of $CH_4$ or strongly diluted by inert gas at near atmospheric pressures, the speed of the reaction of oxidation on the initial stage is determined by the speed of the thermal decomposition of methane. R.T.K.

**N64-14441** Aerojet-General Corp., Sacramento, Calif. Solid Rocket Plant
**ANALYSIS OF PROPELLANT IGNITION, AND ITS APPLICATION TO MOTOR INITIATION**
R. L. Lovine, L. Y. Fong, and B. E. Paul 4 Nov. 1963 40 p refs
(Tech. Memo. 235 SRP)

In order to relate igniter energy output to motor ignition, a model of solid-propellant ignition is given. Difficulties inherent in the nonlinear partial differential equations of heat and mass diffusion describing the ignition system prevent the model from being completely analytical. However, certain results are derived from the equations, and when combined with arc-image furnace ignitibility data, a reasonably coherent view of the process is obtained. Numerous examples of ignitibility data are given. Analysis of heat and mass transfer from igniter to motor grain is given for the case of propellant-type igniter. This analysis, along with the pertinent ignitibility data, is applied to ignition of the second stage Minuteman motor. Author

**N64-14465** Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
**INITIATION OF DETONATION BY LOW AMPLITUDE SHOCKS Quarterly Report, 1 Aug.-31 Oct. 1963**
F. C. Gibson, R. W. Watson, J. E. Hay, C. R. Summers, and F. H. Scott 11 Dec. 1963 24 p refs
(ARPA Order 44-63)
(AD-428376)

Evidence presented in an earlier report of this series indicated that stable low-velocity detonation in nitroglycerin-ethylene glycol dinitrate (NG-EGDN) could be attained under certain environmental conditions. These preliminary results have now been verified in an extended photographic study of the effects of confining wall material and thickness on the stability of low-velocity detonation in NG-EGDN. Photographic studies in both cylindrical tubes and cubical containers have shown that severe cavitation precedes the onset of violent chemical reactions. During the initiation phase of low-velocity detonation, the rarefaction leading to cavitation can enter the liquid along the axis of the system in the direction of the initial shock input or can originate at the laterally expanding container walls. Also, studies of nitromethane and tetranitromethane liquid-explosive systems are discussed. I.v.L.

**N64-14547** Princeton U., N.J. Guggenheim Labs. for the Aerospace Propulsion Sciences
**THE MEASUREMENT OF TEMPERATURE PROFILES THROUGH SOLID PROPELLANT FLAMES USING FINE THERMOCOUPLES**
A. J. Sabadell, J. Wenograd, and M. Summerfield N.Y., Am. Inst. of Aeron. and Astronautics [1964] 9 p refs Presented at the AIAA Solid Propellant Rocket Conf., Palo Alto, Calif., 29–31 Jan. 1964
(Contract Nonr-1858(32); Partially supported by NASA)
(AIAA Paper 64-106) AIAA: $0.50 members, $1.00 nonmembers

Temperature profiles in the solid preheat zone and gaseous combustion zone of burning solid propellants have been obtained by recording voltage from fine thermocouples embedded in burning solid-propellant strands. These temperature records were used to estimate the surface temperature of the burning solid. Techniques have been developed for routine fabrication and handling of fine (0.0003 in.) noble metal thermocouples. Surface temperatures were estimated by noting departure from pure conductive heat flow in a solid continuum. Variations of pressure and particle size and introduction of catalysts failed to give observable changes in surface temperature. The shapes of these temperature profiles can be used to deduce the site of energetic chemical reactions in the combustion zone. These observations demonstrate important differences in combustion mechanism between composite and double-base propellants. Author

**N64-14548** Princeton U., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences
**IGNITION OF AN EVAPORATING FUEL IN A HOT, STAGNANT GAS CONTAINING AN OXIDIZER**
C. E. Hermance, R. Shinnar, and M. Summerfield N.Y., Am. Inst. of Aeron. and Astronautics [1964] 14 p refs Presented at the AIAA Solid Propellant Rocket Conf., Palo Alto, Calif. 29–31 Jan. 1964
(Supported by NASA and AFOSR)
(AIAA Paper 64-118) AIAA: $0.50 members, $1.00 nonmembers

The theoretical characteristics of ignition in heterogeneous systems have not been established heretofore. In this paper, these characteristics were found first by similarity theory and then by numerical analysis of the systems' mathematical models. It was found that certain common simplifying assumptions and ignition criteria, valid for homogeneous systems, are invalid in heterogeneous systems. In heterogeneous systems with igniter gas temperatures near E/R, the particular choice of ignition criterion affects the formula connecting the ignition delay and the chemical or physical parameters of the gas phase. Furthermore, a log–log plot of ignition delay versus concentration of gaseous oxidizer exhibits a variable slope having any negative value, and is not a simple multiple of the controlling reaction order. These theoretical results require verification by critically designed experiments. Author

**N64-14574** Astropower, Inc., Newport Beach, Calif.
**COMBUSTION AND DISINTEGRATION OF ZIRCONIUM HYDRIDE-URANIUM FUEL RODS**
F. E. Littman and A. E. Levy-Pascal *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 261–278 refs (See N64-14551 06-01) OTS: $4.50

Nuclear auxiliary power systems will be carried by many satellites to operate their instruments. If the satellites are designed to return to earth at the end of their missions, the nuclear reactors containing radioactive products constitute a potential hazard. Of the several possible means of disposal, incineration during reentry seems the most promising, particularly if the resulting combustion products are finely divided and widely dispersed before finally falling out. The combustion behavior of relatively massive pieces of fuel elements and the behavior of small molten droplets resulting from a primary breakup of the fuel elements during reentry were investigated. The results of these studies suggest that the probable mode of disintegration of zirconium hydride-uranium fuel rods is a strong function of their reentry trajectory, which in turn depends primarily upon the ejection altitude. R.T.K.

**N64-14694** Aerojet-General Nucleonics, San Ramon, Calif.
**SELECTED SYNTHESIS BY FISSION FRAGMENT RECOIL Quarterly Progress Report No. 2, 1 Oct.-31 Dec. 1963**

A. R. Miller Jan. 1964 16 p refs
(Contract AF 04(611)-9069)
(AN-1119; AD-427863)

This report describes work on a program to synthesize two high-energy liquid oxidizers by fission fragment radiolysis. Calibration of the fuel-capsule system was completed. An analysis of purified reactant gases showed that a measurable amount of air is not introduced during capsule loading and gas sampling. Author

**N64-14742*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**LOW PRESSURE ROCKET EXTINCTION**
Floyd A. Anderson, Roger A. Strehlow (Ill. U.), and Leon D. Strand Repr. from AIAA Journal, v. 1, Nov. 1963 p 2669–2671
(NASA Contract NAS7-100)
(NASA CR-53037; JPL-TR-32-509)

This preliminary work indicates that a few experimental vacuum firings using regressive grains can be used to determine the low pressure limit for any particular propellant formulation. Author

**N64-14785** British Internal Combustion Engine Research Assn., Slough
**COMBUSTION IN DIESEL ENGINES Quarterly Technical Summary Report No. 1**
D. W. Tryhorn 27 Nov. 1963 3 p
(Contract DA-91-591-EUC-2974)
(AD-429013) OTS: $1.10

Improvement was obtained in the performance of a test engine with an early inlet-valve closing by the adoption of a masked inlet valve. Results were obtained at 150 psi BMEP with charge temperatures of 30°, 70°, and 115° C. Another test engine was installed in order to demonstrate the effect of changes in compression temperature in an engine with a multihole nozzle spraying into the piston bowl. R.T.K.

**N64-14794** Aerojet-General Corp., Azusa, Calif.
**INVESTIGATION OF THE MECHANISMS OF DECOMPOSITION, COMBUSTION, AND DETONATION OF SOLIDS Fifteenth Technical Operating Report, 1 Jul.–30 Sep. 1963**
J. P. Kispersky Nov. 1963 16 p refs
(Contract AF 49(638)-851; ARPA Order 24-60)
(Rept. 0372-01-15; AD-428627)

Reanalysis of the apparent flame strength data for the ammonia–oxygen system indicates that the overall order of the $NH_3$-$O_2$ reaction is 1.7, rather than 2.0 as was reported previously. Opposed-jet measurements at 300 torr show that the apparent flame strength of the ammonia–oxygen–chlorine system varies inversely with the mass fraction of chlorine in the initial mixture. This result agrees with the results of previous measurements at 745 torr. The apparent flame strength of the ammonia–nitrogen dioxide system has been determined as a function of reactor pressure between 400 and 745 torr. At 1 atm, the measured apparent flame strength of 1.13 g/cm$^2$-sec. corresponds to a volumetric rate of fuel consumption of 2.15 g/cm$^3$-sec. The apparent flame strength versus pressure data indicates that the overall reaction order is 2.45. Author

**N64-14798** Suffield Experimental Station, Ralston, Alberta (Canada)
**A LISTING OF INTERNAL PUBLICATIONS ON SES SHOCK AND BLAST RESEARCH**
J. C. Muirhead 17 Sep. 1963 7 p refs
(SES-SP-34)

This listing includes work directly and indirectly related to shock and blast research. C.L.W.

**N64-14820** Lockheed Propulsion Co., Redlands, Calif.
**SOLID PROPELLANT STRUCTURAL INTEGRITY INVESTIGATIONS. DYNAMIC RESPONSE AND FAILURE MECHANISMS Research Contract Status Report No. 11, 21 Nov.–20 Dec. 1963**
J. E. Fitzgerald 8 Jan. 1964 9 p
(Contract AF 04(611)-8539)
(LPC-618-P-11; AD-429088) OTS: $1.10

Progress is reported in the investigation of dynamic response behavior of composite propellants, and in the study of the mechanism of propellant rupture. Also reported is progress in the general areas of finite deformation study, vibration mode analysis for case-bonded viscoelastic grains under isothermal and nonisothermal steady state thermal field conditions, and dynamic heat generation in viscoelastic materials. Author

**N64-14863*** Acoustica Associates, Inc., Los Angeles
**ACCELERATION OF BURNING RATE OF COMPOSITE PROPELLANTS BY SOUND WAVES**
Isidor Elias, Henry Cheung, and Norman Cohen (Aerojet-Gen. Corp.) N.Y., Am. Inst. of Aeron. and Astron. [1964] 11 p refs Presented at the AIAA Solid Propellant Rocket Conf., Palo Alto, Calif. 29–31 Jan. 1964
(NASA Contract NASw-64; NASA Contract NAS7-69)
(AIAA Paper 64-108) AIAA: $0.50 members, $1.00 nonmembers

The effect of a controlled sound field, produced by a helium-excited whistle, on the burning of an ammonium perchlorate–polyurethane-type composite solid propellant in rocket motors was investigated. Results indicate that: (1) The burning rate of the propellant can be increased by irradiation of the burning surface by a traveling wave sound field. (2) The burning rate increase does not appear to be a strong function of the mass flow of helium; therefore, practical use of a helium-excited whistle would not have serious logistic disadvantages. (3) The effect of sound decreases with increasing pressure. (4) Stop-fire tests have established that the grain burns normally in parallel layers at an accelerated rate when irradiated by the sound field. (5) The sound field produced by the whistle operating in a rocket motor has amplitudes higher than those predicted from a cold flow whistle calibration. I.v.L.

**N64-14854*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**ALUMINA SIZE DISTRIBUTIONS FROM HIGH-PRESSURE COMPOSITE SOLID-PROPELLANT COMBUSTION**
Louis A. Povinelli and Robert A. Rosenstein N.Y., Am. Inst. of Aeron. and Astron. [1964] 10 p refs Presented at the AIAA Solid Propellant Rocket Conf., Palo Alto, Calif., 29–31 Jan. 1964
(AIAA Paper 64-115) AIAA: $0.50 members, $1.00 nonmembers

Alumina size distributions were obtained for both a coarse and a fine oxidizer composite propellant burning in a nitrogen atmosphere over the pressure range from atmospheric to 500 psi. The amount of additive agglomeration was found to be significantly higher for the coarse oxidizer propellant and decreased with increasing pressure to the 0.3 power over the range from atmospheric pressure to 250 psi. High-speed photographs of the burning propellant surface revealed that the additives moved on the surface with the average particle velocity decreasing

with pressure to approximately the 0.3 power over the pressure range from atmospheric to 50 psi. The volume mean diameter of the alumina was found to decrease with increasing pressure. Author

**N64-14856*** Princeton U., N.J. Guggenheim Labs. for the Aerospace Propulsion Sciences
**A STUDY OF THE IGNITION OF SOLID PROPELLANTS IN A SMALL ROCKET MOTOR**
E. H. Grant, Jr., R. W. Lancaster, J. Wenograd, and M. Summerfield N.Y., Am. Inst. of Aeron. and Astron. [1964] 11 p refs Presented at the AIAA Solid Propellant Rocket Conf., Palo Alto, Calif., 29–31 Jan. 1964
(Sponsored by NASA and AF)
(AIAA Paper 64-153) AIAA: $0.50 members, $1.00 nonmembers

A small rocket motor that permitted systematic variation of heat transfer rate, chemical reactivity of the igniting gas, flame temperature, mass flow, and chamber pressure was developed for investigating the essential nature of practical ignition processes. In this motor, hot gaseous products from a controllable gas-fed torch were used to apply heat to the internal surface of a cylindrical grain. To simplify interpretation, heat-transfer rate was held constant by maintaining constant mass flow and flame temperature while pressure and oxygen concentration of the test gas were varied. Oxygen concentration (0% to 75% by weight) and pressure (35 to 80 psia) influenced the ignition delay time significantly. Ignition delays for one composite propellant varied from 3 to 37 msec. These results demonstrate the strong influence of gas phase properties on solid-propellant ignition delay and substantiate theoretical models of ignition that include such effects. Author

**N64-14932** Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
**AIR FLOWS INTO UNCONTROLLED FIRES Final Report**
Alexander Strasser and Joseph Grumer 8 Jan. 1964 63 p refs
(BM-3909)

Experiments were conducted with fuel beds having diameters up to 100 cm of ordered and unordered arrays of wood blocks. Measurements were made of the static pressure within the fire and the chemical composition of the flame gases. Burning rates and airflows into the fuel beds were measured; the measured airflows were low and did not increase with increased diameter of fuel bed or with other fuel bed parameters. It is concluded that the condition of the fuel bed alone does not determine the development of a firestorm. The most likely hypothesis is that a large fire will precipitate airflows in a metastable atmosphere with a superadiabatic lapse rate; perhaps, in the absence of a metastable atmosphere, a firestorm cannot be generated. Author

**N64-14977** Southwest Research Inst., San Antonio, Tex.
**A STUDY OF RAPID SOLIDIFICATION OF HYDROCARBON FUELS Interim Report, Feb. 15, 1962–Feb. 14, 1963**
Jan Al Ft. Eustis, Va., Army Transportation Res. Command, Oct. 1963 84 p
(Contract DA-44-177-TC-819)
(TRECOM-TR-63-50; AD-426127)

Progress is reported on rapid methods for gelling aircraft fuels. One of the more promising systems developed is the use of fatty amines and tolylene diisocyanates. Systems were developed that will gel fuel with as low as 1.0 w/o additives. The rate of gelation and the properties of the gel are influenced by the structure of the amine and the diisocyanate. Pure 2,4-tolylene diisocyanate and lauryl amine yield a soluble product. With mixtures of the 2,4-isomer and 2,6-isomer, the rate of gel formation and the rigidity of the gel increase as the concentration of the 2,6-isomer increases. With pure 2,6-tolylene diisocyanate and lauryl amine, the rate is so fast that adequate mixing cannot be obtained using normal laboratory techniques. Author

# 27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

**N64-14387** Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
**LIFE PLUS RELIABILITY**
A. Pugachev and N. Domotenko 25 Oct. 1963 8 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), v. 20, no. 4, 1963 p 16–17
(FTD-MT-63-108/1+2+3+4; AD-428558) OTS: $1.10

Attention was directed toward the increase in the resources (life and reliability) of the AI-20 aircraft engine. Taken into consideration were the joint efforts of designers, scientific research organizations, operational subdivisions, and aircraft repair factories. Also studied were the methods taken to increase life and reliability of the engine. C.L.W.

**N64-14508** Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
**FEASIBILITY DEMONSTRATION OF A TRANSPIRATION COOLED NOZZLE SYSTEM Interim Report No. 2, 15 Sep.–14 Dec. 1963**
1963 74 p refs
(Contract AF 04(611)-9071)
(TRW-ER-5209-Q2; RTD-TDR-63-1074; AD-428168)

The following specific items were accomplished, and discussions of each are contained in the report: (1) Bench tests were conducted to substantiate flow relationships, verify heat-transfer analyses, evaluate the effect of infiltrants, and investigate particle impingement. Also, laboratory tests to determine the physical properties of porous tungsten were completed. (2) The thermal stress analysis was refined to incorporate the Von Mises yield criterion and the effect of plastic flow and shape redistribution on the resulting stresses. (3) The scale-up process to produce full-size inserts was completed, and three full-size porous inserts were thermal shock tested with no failures. (4) Joining investigations were completed on brazing and welding tantalum directly to porous tungsten. As a part of this investigation, a study was initiated to determine the feasibility of welding tantalum to a dense tungsten ring which is embedded in the porous insert during the sintering process. Author

**N64-14564** Los Alamos Scientific Lab., Albuquerque, N.Mex.
**A BRIEF DESCRIPTION OF THE ROVER-TYPE REACTOR-ITS INHERENT SAFETY PROBLEMS AND TEST PROGRAMS**
L. D. P. King *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 145–153 ref (See N64-14551 06-01) OTS: $4.50

The principal Kiwi-B4 reactor components are described, and an analysis is presented of Rover flight safety program in the following areas: (1) the determination of the magnitude, the probability and the consequences of nuclear incidents on or near the launch pad and the means of preventing such potential accidents; and (2) the disposal after reactor operation of the highly radioactive core in a manner that does not expose the general public to undue hazards. R.T.K.

**N64-14567** Ling-Temco-Vought, Inc., Dallas, Tex.
**NUCLEAR RAMJET MISSILE FLIGHT SAFETY**
W. J. Hesse and J. E. Standefer *In* Sandia Corp., Aerospace Nucl. Safety Jan. 1964 p 181–192 refs (See N64-14551 06-01) OTS: $4.50

A discussion is presented of the feasibility of safely flight testing nuclear ramjet missiles without increasing present levels of contamination and without exposing personnel to radiation in excess of those levels recommended by organizations such as the Federal Radiation Council. R.T.K.

**N64-14627** Rocket Power, Inc., Pasadena, Calif.
**STUDY OF ROCKET ENGINE EXHAUST PRODUCTS Ninth Quarterly Report, 1 Jun. 1963–31 Aug. 1963**
M. A. Greenbaum, R. E. Yates, J. A. Blauer, M. Arshadi, and H. C. Ko et al [1963] 15 p refs
(Contract AF 04(611)-7414)
(QR-7414-9; AD-426166)

The heat and entropy of sublimation of $MgF_2$ have been determined over the temperature range 1,273° to 1,513° K from a study of the vapor pressure of $MgF_2$(s). Based on the experimental data combined with available thermal functions, the second-law value for $\Delta H^{298}_{sub}$ was found to be 83.21 ±1.03 kcal/mole. The corresponding third-law value obtained was 83.95 ±0.65 kcal/mole. The experimental $\Delta S^{298}_{sub}$ was found to be 41.78 ±0.75 cal/deg/mole. Preliminary information on the nature of the BeO(s)–$H_2O$(g) reaction in the temperature range 1,538° to 1,738° K and at $10^{-4}$ atm pressure has been obtained. Author

**N64-14687** Martin Co., Denver, Colo.
**DEVELOPMENT AND DEMONSTRATION OF MAIN TANK INJECTION (MTI) PRESSURIZATION SYSTEM Final Report, 1 Jun. 1962-[Sep. 1963]**
R. J. Kenny, P. Freedman, A. P. Lane, and P. Bingham Edwards AFB, Calif., AF Flight Test Center, Dec. 1963 580 p refs
(Contract AF 04(611)-8198)
(FTC-CR-63-23; RTD-TDR-63-1123; AD-426714)

The overall program was conducted in four phases: (1) preliminary investigations including the basic research and development of a small-scale system; (2) design and fabrication of a flight-type test article; (3) full-scale system development and demonstration test; and (4) system analysis resulting in the formulation of a design handbook and study of specific vehicle applications. Considerable experimental data were accumulated during the course of the program and were analyzed to identify pertinent effects resulting from the chemical pressurization process. Composition and properties of the pressurizing gas and rate of ullage saturation with propellant vapors are reported based on extensive mass spectrometer gas analysis. An investigation of propellant degradation due to the reaction process and dilution by condensate is also included. Author

**N64-14808** Lockheed Aircraft Corp., Burbank, Calif.
**INLET-EXHAUST-THRUST REVERSER PROGRAM FOR THE COMMERCIAL SUPERSONIC TRANSPORT Final Report**
John L. Benson 26 Jul. 1963 233 p refs
(Contract AF 33(657)-9433)
(LR-16261-3; AD-429079) OTS: $15.50

A comprehensive examination of various analytical methods that describe the dynamics of supersonic air induction systems has been made. An analytical procedure has been developed, which, it is believed, accurately describes the steady-state and dynamic behavior of fixed or variable geometry supersonic inlet systems. Transfer functions, derived from results of a one-dimensional Method of Characteristics solution, in combination with a simple lumped volume representation form the foundation of an analytical inlet model, which, when combined with derived models of a control system and engine, can be used to predict the steady-state and transient performance of an entire propulsion system package. A study was also conducted to define the nature of both internal and external disturbances that could occur in flight. These disturbances were imposed on the systems to demonstrate the capability of the system representations. Results are also presented that show the effect of the mutual interaction between a propulsion system and aircraft representation at supersonic speeds. Author

**N64-14824** Rocketdyne, Canoga Park, Calif.
**SELF-COOLED ROCKET NOZZLES Quarterly Progress Report, 1 Oct.–31 Dec. 1962**
J. D. Seader, R. J. Ingram, P. Schwarzkopf, and E. D. Weisert 30 Jan. 1963 82 p refs
(Contract AF 33(657)-9166)
(R-3853-2; AD-429082)

Progress in reducing a comprehensive theoretical analysis to a digital computer program is described. Implications of a simplified analysis are considered. The results of initial screening of materials with a very small rocket motor are presented. Fabrication procedures developed for tungsten composites are reviewed, as is the design of a larger size rocket motor for materials testing. Author

**N64-14825** Rocketdyne, Canoga Park, Calif.
**SELF-COOLED ROCKET NOZZLES Quarterly Progress Report, 1 Aug.–31 Oct. 1963**
P. Schwarzkopf and E. D. Weisert 30 Nov. 1963 18 p ref
(Contract AF 33(657)-9166)
(R-3853-4; AD-429083)

The initial development of fabrication techniques to produce tungsten matrixes of complex porosity is described. These techniques will be used to prepare nozzles for testing in a solid-fuel subscale motor and a liquid-fuel simulator. The theoretical analysis of self-cooling has been reprogramed to include temperature-variable matrix properties and graded matrix porosity. Author

**N64-14859*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**POTENTIALS OF RADIOISOTOPE ELECTROSTATIC PROPULSION SYSTEMS USING Ce-144 AS FUEL AND INCORPORATED INTO SMALL VEHICLES CAPABLE OF BEING MATED TO AVAILABLE CHEMICAL BOOSTERS COULD PROVIDE GOOD PERFORMANCE IN VARIOUS MISSIONS WITHOUT UNDUE RADIATION HAZARDS**
William R. Mickelsen and Charles A. Low, Jr. Repr. from Astronautics and Aerospace Eng. Oct. 1963 p 52–57 refs
(NASA RP-119)

The anticipated availability of the $Ce^{144}$ radioisotope as a byproduct from ground-based power reactors is sufficient for propulsion systems of 10 to 50 kwe (electric) in 1967 and 100 to 500 kwe in 1980. The payload radiation dose caused by $Ce^{144}$ electrogenerators has been shown to be within acceptable limits even without shielding. The radioisotope electrostatic propulsion system has been shown to be of sufficiently small size for convenient mating with chemical boosters such as the Atlas-Agena and the Centaur. The theoretical performance of the radioisotope system on space probe missions, such as Mars and Saturn orbiters, betters other propulsion systems. Ground handling and launch-pad radiation hazards are serious problems, but it appears that radiation dosage can be reduced to safe levels with simple shielding. A cursory analysis has shown that the use of a $Ce^{144}$ system for manned interplanetary flight may be possible. Massive components such

as solar flare shelters and/or the propellant appear to be adequate for shielding the crew from $Ce^{144}$ gamma radiation. Radioisotope availability and cost should not be deterrents to the radioisotope electrostatic propulsion system. I.v.L.

**N64-14986*** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
**EFFECT OF INTERCHANGING PROPELLANTS ON ROCKET COMBUSTOR PERFORMANCE WITH COAXIAL INJECTION**
Martin Hersch Washington, NASA, Feb. 1964 23 p refs
(NASA TN D-2169) OTS: $0.75

The effect of reversing propellants in coaxial injection on combustor performance was determined with a nominal 200-pound-thrust rocket combustor burning gaseous hydrogen with liquid oxygen. Reversing propellants refers to the change from oxidant in the tube to fuel in the tube. The effect of this change was determined by measuring characteristicvelocity efficiency for a combustor having two interchangeable injectors. The injectors were designed so that the propellants could be reversed without changing their respective injection flow areas. The performance was evaluated for three chamber lengths over a range of oxidant–fuel weight ratios from about 1.5 to 10 and for various total propellant flow rates. Higher performance was obtained when the liquid oxygen was injected from the annulus. It was also observed that the combustion noise level was lower with annularly injected liquid oxygen. Also, with annular oxygen injection, the injector face was less subject to high heat-transfer rates. Author

# 28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

**N64-14181*** Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research
**SOME ASPECTS OF THE STRUCTURE AND DYNAMICS OF THE TERRESTRIAL MAGNETOSPHERE**
W. I. Axford Aug. 1963 62 p refs Presented to NATO Inst. on Extremely Low Freq. Emissions, Bad Homburg, Germany, Jul. 1963 Submitted for Publication
(NASA Grant NsG-382)
(NASA CR-55342; CRSR-151) OTS: $6.60 ph, $2.06 mf

A discussion is presented of the solar wind, its interaction with the earth, and the resulting formation of the earth's magnetosphere. The discussion is divided into the following topics: (1) the magnetosphere—cavity formation, shock waves, theoretical discussion of the structure of the magnetosphere, and observations of the shape of the magnetosphere; (2) motions in the magnetosphere—theoretical aspects, energization of charged particles due to motions in the magnetosphere, rotational motion of the magnetosphere, motions corresponding to the ionospheric electric-current systems, magnetospheric motions associated with polar-current system, and conjugate point variations; and (3) disturbance phenomena in the outer magnetosphere—the theory of Axford and Hines, the viscous interaction hypothesis, and the morphology of high-latitude disturbance phenomena. P.V.E.

**N64-14287*** Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research
**VISCOUS INTERACTION BETWEEN THE SOLAR WIND AND THE EARTH'S MAGNETOSPHERE**
W. I. Axford Sep. 1963 29 p refs Submitted for Publication
(NASA Grant NsG-382)
(NASA CR-55341; CRSR-153) OTS: $2.60 ph, $1.07 mf

Order of magnitude calculations are used to show that viscous interaction between the solar wind and the earth's magnetosphere can satisfy the energy requirements of a typical magnetic storm. The viscous interaction is considered to be due mainly to turbulence of a compressible nature in the solar wind, and it is shown that this can provide the necessary drag forces, although other mechanisms are not excluded. Author

**N64-14318** Avco-Everett Research Lab., Everett, Mass.
**MAGNETIC FIELD ANNIHILATION**
H. E. Petschek Oct. 1963 37 p Presented at the Solar Flare Symp., Goddard Space Flight Center, Greenbelt, Md., Oct. 28-30, 1963
(Contract Nonr-2524(00))
(AMP-123; AD-425751)

Sweet's mechanism for the rate of annihilation of magnetic field at the boundary between two regions of plasma containing oppositely directed field lines is reexamined. Previous analyses overlooked standing magnetohydrodynamic waves as a possible mechanism for converting magnetic energy to plasma energy. An estimate of the annihilation rate including such waves is made. Using this rate it is found that the energy required for a flare can be released in $10^2$ sec. This time is short enough to account for the observed solar flare times if the source of the flare energy is stored magnetic energy. Author

**N64-14357** High Altitude Observatory, Boulder, Colo. Natl. Center for Atmospheric Research
**INTEGRATED INDICES OF THE SOLAR CORONA, 1962**
Dorothy E. Trotter 15 Jul. 1963 9 p refs
(Supported by NBS and AFCRL)
(HAO-58; AD-428370) OTS: $1.10

The 1962 daily mean, integrated coronal indices are presented for: (1) the λ6374 emission line (Fe X) for the visible solar disk and for the whole sun; and (2) the λ5303 emission line (Fe XIV) for the visible solar disk and for the whole sun. The index for a given date is the mean of all the daily eastern quadrant indices for the 13 preceding days and of all the western quadrant indices for the 13 subsequent days. P.V.E.

**N64-14488** Naval Research Lab., Washington, D.C.
**THE PRIMARY COSMIC RADIATION**
M. M. Shapiro 25 Apr. 1963 11 p refs Presented at a lecture at the Enrico Fermi Intern. School of Phys., Varenna, Italy, Aug. 1962
(NRL-5896; AD-404746)

This paper sketches some salient features of the cosmic radiation incident upon the earth and discusses implications of the Li-Be-B anomaly and the helium isotope abundances. The abundance ratio of cosmic-ray hydrogen to helium is similar to that for the thermal abundances in the sun and nearby stars. The other nuclei, particularly Li, Be, and B, are overabundant relative to hydrogen. Lower limits of cosmic-ray-particle flux and density for total energies exceeding $1.7 \times 10^9$ ev per nucleon are 0.28 particle/$cm^2$-sec-sterad and $1.2 \times 10^{-10}$/$cm^3$, respectively. The energy density is comparable to that of starlight. Measurements indicate that the cosmic-ray abundance of Li, Be, and B at kinetic energies above $1.5 \times 10^9$ ev/nucleon is $2 \times 10^5$ times their general abundance. An assumption that this overabundance arises from the breakup of heavier nuclei permits estimates of the amount of interstellar hydrogen traversed, one estimate being 2.5 g/$cm^2$. Author

**N64-14857*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**HYDROGEN, HELIUM, AND HEAVY NUCLEI FROM THE SOLAR EVENT ON NOVEMBER 15, 1960**
S. Biswas, C. E. Fichtel, D. E. Guss, and C. J. Waddington Repr. from J. Geophys. Res., v. 68, no. 10, May 15, 1963 p 3109–3122
(NASA RP-19)

It was found that the helium and medium nuclei had similar energy spectra, steeper than those of protons in the energy interval from about 30 to 130 Mev/nucleon. The rigidity spectrums of hydrogen, helium, and medium nuclei were similar within experimental errors. The relative abundances of He, C, N, O, and heavier nuclei were the same within the uncertainties each time a measurement was made. The average ratio of the helium to medium nuclei is 60 ± 7. The composition of these nuclei is similar to that of the solar atmosphere but significantly different from that of the galactic cosmic rays. The time dependence of the ratios of the protons to helium nuclei and protons to medium nuclei is compared with the predictions of the models for the solar particle propagation of Parker and Gold. The experimental results are found to be consistent with a general diffusion model having strong scattering centers in the inner solar system and a boundary region consisting of progressively weaker scattering centers at large distances from the sun. Author

**N64-14868*** Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies
**COSMIC RADIATION**
Peter Meyer [1963] 32 p refs Presented at the IGY/IGC Symp., Los Angeles, Aug. 1963
(NASA Grant NsG-144-61)
(NASA CR-55438; EFINS 63-68) OTS: $3.60 ph, $1.16 mf

A discussion is given concerning the exploration of the physical phenomena in interplanetary space, phenomena which are controlled by the outflux of energy from the sun. This energy is emitted essentially in two forms—electromagnetic radiation and particle radiation. The latter form, particle radiation, holds scientific interest in connection with galactic cosmic radiation. Therefore, this discussion has been restricted to cosmic research related to solar and interplanetary physics. C.L.W.

# 29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

**N64-14175*** Lockheed Missiles and Space Co., Palo Alto, Calif.
**SPACE FLIGHT HANDBOOKS. VOLUME 3: PLANETARY FLIGHT HANDBOOK**
Stanley Ross et al Washington, NASA, 1963 280 p refs
(NASA Contract NAS8-5031)
(NASA SP-35, Pt. I) OTS: $4.00

Part one is given of a series of maps, graphs, and tables that will be of use to the preliminary-design analyst in scheduling round-trip interplanetary missions to Mars and Venus in the time period 1965–1999. The following are presented: maps for obtaining departure and arrival speeds for trips to these planets, a listing of useful constants and planetary ephemerides, tables of important occurrences, and a number of auxiliary graphs. Included are the calculation of interplanetary trajectories, stopover missions, nonstop missions, supplementary graphs and charts, tables of constants and planetary phenomena, and planetary positions and velocities. C.L.W.

**N64-14176*** Lockheed Missiles and Space Co., Palo Alto, Calif.
**SPACE FLIGHT HANDBOOKS. VOLUME 3: PLANETARY FLIGHT HANDBOOK**
Washington, NASA, 1963 522 p
(NASA Contract NAS8-5031)
(NASA SP-35, Pt. 2) OTS: $7.00

Tabulations are given of trajectory data for scheduling flights to Venus and Mars during the period 1960–2000. Data are presented for single-plane transfers and for broken-plane transfers that employ a midcourse plane-change. The data at the target planet are held fixed while the trip duration is varied in 10-day increments from zero days to the length of that planet's synodic period with the Earth. Only those trips are listed for which the hyperbolic excess speeds at either or both ends of the trajectory do not exceed 0.6 EMOS (Earth mean orbit speed). For each departure–arrival date pair, all trajectories are listed that connect the given planets on those dates, and the tabulation accounts for all possible multiple-circuit arcs but does not include retrograde flights. P.V.E.

**N64-14177*** Lockheed Missiles and Space Co., Palo Alto, Calif.
**SPACE FLIGHT HANDBOOKS. VOLUME 3: PLANETARY FLIGHT HANDBOOK**
Washington, NASA, 1963 530 p
(NASA Contract NAS8-5031)
(NASA SP-35, Pt. 3) OTS: $7.00

Information is presented concerning trajectories for returning from the planets Venus and Mars during the period 1960–2000. Data are given in tabular form for: single-plane transfers from Venus to Earth 1970–1986, single-plane transfers from Mars to Earth 1960–1980, broken-plane transfers from Venus to Earth 1970–1986, and broken-plane transfers from Mars to Earth 1965–1980. R.T.K.

**N64-14249** Canadian Armament Research and Development Establishment, Valcartier
**SPACE DEBRIS AND SPACE FLIGHT**
H. P. Tardif Apr. 1963 28 p refs
(CARDE TM-720/63; AD-408253)

This memorandum is essentially a literature survey on the problem of space flight in a meteoritic environment. It covers in a general manner the fields of meteoritic environment, the deterioration of the skin of a spaceship under impacts by meteoroids, and the methods published to date for the prevention of such damage. Author

**N64-14254** Joint Publications Research Service, Washington, D.C.
**EXTRATERRESTRIAL STATIONS**
V.P. Glushko 29 Jan. 1964 6 p Transl. into ENGLISH of an article from Nauk i tekhn. (Riga), no. 40 (185), Oct. 1962 p 3–4
(JPRS-22972; OTS-64-21427) OTS: $0.50

The potential practical applications of a revolving observatory in outer space are discussed. R.T.K.

**N64-14270*** National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
**A THEORETICAL STUDY OF THE MARTIAN IONOSPHERE**

R. B. Norton [1963] 16 p refs Presented at the Am. Astronautical Soc. Symp. on the Exploration of Mars
(NASA Order R-65)
(NASA CR-55362) OTS: $1.60 ph, $0.80 mf

A theoretical study, based on a neutral atmosphere composed of 2% carbon dioxide and 98% molecular nitrogen, indicates that the Martian ionosphere would occur higher above the planet's surface than does the terrestrial ionosphere, but at about the same total pressure. The maximum electron density for overhead sun is about $2 \times 10^5$ $cm^3$ as compared to about $10^6$ $cm^3$ on earth. On Mars there may be layers that absorb radio waves more strongly than the normal terrestrial D region.
Author

**N64-14276*** Boston U., Mass.
**CATALOG OF LUNAR CRATERS III Research Report No. 8**
Gerald S. Hawkins and Peter W. Mitchell Nov. 1963 26 p refs
(NASA Grant NsG-246-62)
(NASA CR-55295; *Its* Astronomical Contributions, Ser. 2, no. 26) OTS: $2.60 ph, $0.98 mf

The selenographic coordinates of all craters observable on a selected portion of the moon's surface are given, together with the diameter of the craters and comments on their shape. The section studied was a strip on sheet C 7-a of the Photographic Lunar Atlas, (Kuiper, 1960). The position found in the present series of measurements is given, along with the name adopted by the International Astronomical Union.
C.L.W.

**N64-14281*** Boston U., Mass.
**REVISED CATALOG OF LUNAR CRATERS II Research Report No. 11**
Gerald S. Hawkins and Peter W. Mitchell Nov. 1963 25 p refs
(NASA Grant NsG-246-62)
(NASA CR-55297; *Its* Astron. Contrib., Ser. 2, no. 28) OTS: $2.60 ph, $0.95 mf

This catalog gives the selenographic coordinates of all craters observable on a selected portion of the moon's surface. The diameter of the crater, together with comments on the shape, is also given. Approximately 15 percent of the craters have been measured previously by other observers. The craters' positions found in the present series of measurements and the name adopted by the International Astronomical Union are presented.
R.T.K.

**N64-14282** Boston U., Mass.
**REVISED CATALOG OF LUNAR CRATERS I Research Report No. 10, November 1963**
Gerald S. Hawkins and Peter W. Mitchell [1963] 25 p refs
(NASA Grant NsG-246-62)
(NASA CR-55296) OTS: $2.60 ph, $0.95 mf

This catalog gives the selenographic coordinates of all craters observable on a selected portion of the moon's surface. The portion studied was a strip on sheet C 5-a of the "Photographic Lunar Atlas" (Kuiper, 1960). The diameters of the craters and comments concerning their shape are given. The position of the geometrical center of the crater rim is also given. If the rim is raised above the mean level of the moon, then the measured center is displaced toward the limb of the moon. This displacement, in general, is less than 1 km and is negligible compared to the uncertainity of defining the rim for a large crater.
I.v.L.

**N64-14393*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**STUDY OF THE USE OF THERMAL CONTROL TECHNIQUES FOR GUIDANCE DURING DIRECT AND SKIP ENTRIES FOR A CAPSULE-TYPE VEHICLE AT PARABOLIC VELOCITY**
John W. Young Washington, NASA, Jan. 1964 47 p refs
(NASA TN D-2055) OTS: $1.25

This report describes a guidance system, based on terminal control techniques, which was developed to control a capsule-type vehicle from parabolic entry conditions to desired terminal conditions. The guidance system makes use of three separate portions of a precomputed reference trajectory to obtain range control for the vehicle. A skip maneuver is utilized to obtain desired ranges greater than about 4,200 international nautical miles from the initial entry point. Results of the study are presented that describe the operation of the system for a number of desired terminal conditions and a variety of off-nominal initial entry conditions. Results are also presented that illustrate the operation of the system in nonstandard atmospheres. From a range-error sensitivity standpoint, optimum skip-out conditions are indicated. The guidance system provides effective range control to desired destinations of from 1,200 to 19,000 nautical miles from the initial entry position.
Author

**N64-14394*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**A STUDY OF FACTORS AFFECTING THE ACCURACY OF POSITION FIX FOR LUNAR TRAJECTORIES**
Margery E. Hannah and Alton P. Mayo Washington, NASA, Jan. 1964 30 p refs
(NASA TN D-2178) OTS: $0.75

The accuracy of the position fix as obtained from simultaneous onboard optical measurements is discussed with respect to the gradients of the measurements. The effectiveness of various navigation measurements in position fixing is discussed. An approximate method for predicting the error ellipsoid for a position-fixing system is developed. The position errors are illustrated by application of the results to a lunar trajectory. Equations for the gradients of various measurements are derived.
Author

**N64-14421** North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
**SPACE LOGISTICS TECHNICAL DOCUMENTATION**
10 Oct. 1962 68 p refs
(SID-62-1215)

An annotated bibliography is presented on the following areas related to space logistics: guided missile containers, data systems, environment control, equipment, Operation Golden Ram, maintainability, mathematical models, personnel, propellant handling, reentry, reliability, rendezvous, rescue systems, satellite base, SLOMAR (Space Logistics, Maintenance and Rescue System), training, and transportation.
R.T.K.

**N64-14438** Douglas Aircraft Co., Inc., Santa Monica, Calif. Missiles and Space Systems Engineering
**AN ERROR ANALYSIS FOR DOPPLER DETERMINED SATELLITE ORBITS OF OTHER PLANETS**
Paula L. Cohen and Armin J. Deutsch [1963] 12 p refs Presented at the 11th I.A.F. Congr., Astrodyn. Colloq., Stockholm, 8 Aug. 1960
(Douglas Eng. Paper 1061)

This paper examines the propagation of errors in the determination from radio Doppler data alone of the orbital elements of a bound satellite. For a typical Kepler orbit around Venus, with the assumption of reasonable values for the frequency stability of the signal and for the rate of acquisition of Doppler data, it is found that the orbital elements can be established with the precision of the order of one percent.
Author

**N64-14572** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**THE SPACE ENVIRONMENT AND ITS IMPLICATIONS FOR SPACECRAFT DESIGN**
J. B. Rittenhouse and F. J. Clauss *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 241–253 refs (See N64-14551 06-01) OTS: $4.50

Special problems on the behavior of materials in outer space arise from both the absence and presence of surrounding matter, that is, from vacuum and from particles in space. These problems and their importance in the design and construction of satellites, space probes, and manned space vehicles are discussed. R.T.K.

**N64-14714** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**METHODS FOR THE NUMERICAL SOLUTION OF EQUATIONS IN FINITE DIFFERENCES AND THEIR APPLICATION TO THE CALCULATIONS OF THE ORBITS OF ARTIFICIAL EARTH SATELLITES**
G. P. Taratynova [1962] 40 p refs Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), no. 4, 1960 p 56–81 (MH-Transl. 365)

These methods are necessary for the solution of certain problems of celestial mechanics, in which the solution to systems of nonlinear differential equations describing the motion over large time intervals is required. Some of these problems are the determination of the lifetime of an artificial satellite and the determination of the evolution of the satellite's orbit within the time of its existence. Author

**N64-14715** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**THE GENERALIZED PROBLEM ON TWO FIXED CENTERS AND ITS APPLICATION IN THE THEORY OF MOTION OF ARTIFICIAL EARTH SATELLITES**
E. P. Aksenov, E. A. Grebenikov, and V. G. Demin [1963] 16 p refs Transl. into ENGLISH from Astron. Zh., v. 40, no. 2, 1963 p 363–372
(MH-Transl. 440)

A solution has been obtained to the problem of 2 fixed centers, provided that the masses of the attracting centers and the distance between them are complex quantities, and the potential of the problem takes only real values for any position of the moving point in space. Author

**N64-14743*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GODDARD MINIMUM VARIANCE ORBIT DETERMINATION PROGRAM**
S. Pines, H. Wolf, D. Woolston, and R. Squires 18 Oct. 1962 66 p refs
(NASA TM X-51488; X-640-62-191) OTS: $6.60 ph, $2.18 mf

The requirements are to develop a general purpose real-time tracking and orbit prediction program with the following features: (1) a rapid, basic-orbit prediction program with high numerical accuracy not subject to numerical round-off error over long time periods; (2) the capability of handling circular, elliptical, and hyperbolic orbits with equal flexibility under the action of perturbation forces; (3) the ability to absorb and utilize inhomogeneous observations from many different sources with equal facility; (4) a theoretically sound statistical process for obtaining information from observations rapidly without requiring large stretches of observations over long time arcs that unduly tax the linear assumptions of the least-squares techniques; (5) a program combining these features as a necessary prerequisite for adequate ground coverage of the Apollo mission and to provide a tracking program for almost any existing space mission. E.W.

**N64-14751** Minneapolis-Honeywell Regulator Co., Minn. Military Products Group
**THE DETERMINATION OF PARAMETERS FOR THE ORBIT OF AN ARTIFICIAL SATELLITE ACCORDING TO DATA OF GROUND MEASURINGS**
T. M. Eneev, A. K. Platronov, and R. K. Kazakova [1962] 22 p Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), no. 4, 1960 p 43–55
(MH-Transl. 369)

This article presents briefly the method for determining the elements of a satellite orbit and the prediction of its motion from the processed data of optical and radiotechnical observations. In its application, the method is oriented for the use of high-speed electronic computers. Author

**N64-14781** Aerospace Corp., El Segundo, Calif. Systems Res. and Planning Div.
**ON THE PROBLEM OF OPTIMAL THRUST PROGRAMMING FOR A LUNAR SOFT LANDING**
J. S. Meditch 15 Dec. 1963 30 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-309; TDR-269(4540-20)-1; AD-429017) OTS: $3.60

The problem of minimal fuel thrust programing for the terminal phase of a lunar soft-landing mission is shown to be equivalent to the minimal time problem for the mission. The existence of an optimal (minimal fuel) thrust program for the problem is then assured by appealing to existence theorems for time optimal controls, and the optimal thrust program is developed by application of the Pontryagin maximum principle. It is shown that the optimal thrust program consists of either full thrust from the initiation of the mission until touchdown, or a period of zero thrust (free-fall) followed by full thrust until touchdown. An approximate switching function that is adequate for a large number of cases is derived, and a preliminary system design is presented. Author

**N64-14841*** California U., Berkeley Space Sciences Lab.
**ON OBSERVATIONS OF LUNAR MAGNETIC STORMS**
A. Palm and S. Silver 9 Jan. 1964 5 p refs
(NASA Grant NsG-243-62)
(NASA CR-55433; *Its* Ser. 5, Issue 3) OTS: $1.10 ph, $0.80 mf

Consideration is given to a plan for obtaining information on geomagnetic phenomena through the stationing of plasma detectors on the moon. Several types of magnetic disturbances are described in order to demonstrate possible differences between selenomagnetic and geomagnetic storms caused by identical solar events. Primary factors are separated from secondary effects due to the earth's environment by correlating recordings of terrestrial magnetic fluctuations and of lunar plasma probes and magnetometers. A single base stationed on the moon for this purpose provides the longest period of time during which a given solar event and its developments can be examined continuously and simultaneously by optical, radiometric and magnetometric methods. C.L.W.

**N64-14843*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**ON THE IONOSPHERIC INTERPRETATION OF THE RESULTS OF RADIO OBSERVATIONS OF VENUS, PART I**

A. D. Danilov and S. P. Yatsenko 29 Nov. 1963 18 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 3, no. 4, 1963 p 585–593
(NASA Contract NAS7-100)
(NASA CR-53052; JPLAI/Trans-30) OTS: $1.60 ph, $0.80 mf

The ionosphere model appears to hold the greatest promise for the explanation of the data obtained by radio observations of Venus. This paper considers the primary difficulties associated with this model and the possible techniques for overcoming these difficulties. Agreement of the ionospheric hypothesis with data resulting from radar studies of Venus can be obtained if the radiation with $c\lambda = 70$ cm is reflected from the maximum of the electron concentration in the ionosphere and the radiation with $c\lambda = 10$ and 40 cm is reflected from the surface of the planet. The high temperature of the radio-frequency radiation of Venus in the centimeter band is explained by the high electron temperature of the ionosphere; the absence of an increase in temperature for the 20-cm band is explained by the presence of an upper layer of lower temperature above the layer with the high electron temperature. Author

**N64-14844*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**A RADAR STUDY OF THE PLANET MARS IN THE SOVIET UNION**
V. A. Kotelnikov, V. M. Dubrovin, B. A. Dubinskiy, M. D. Kislik, B. I. Kuznetsov et al 18 Dec. 1963 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 151, no. 4, 1963 p 811–814
(NASA Contract NAS7-100)
(NASA CR-53051; JPLAI/Trans-31) OTS: $1.60 ph, $0.80 mf

Results of a radar study of Mars during February 6 to 10, 1963 include the following: (1) The value of the astronomical unit A, 149,599,300 km, obtained by a radar study of Venus was confirmed. (2) The total width of the spectrum of the reflected signals at the 700-mc frequency, accounting for the tilt of the axis of rotation, can attain 2200 cps for Mars, whose period of rotation is 24 hr 37 min. The reception of a narrow-band spectrum from a planet with a high rate of rotation indicates the existence on the surface of Mars of fairly smooth horizontal areas with dimensions of several kilometers or more. (3) The average reflection coefficient of Mars, defined as the ratio of the energy of the reflected signals in a 4-cps bandwidth, during the 48 test observations, to the energy of the signals that would have been received if Mars were a smooth ideally conducting sphere was found to be 7%. I.v.L.

**N64-14845*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**TELECOMMUNICATION ASPECTS OF A MANNED MARS MISSION**
W. K. Victor, R. Titsworth, and E. Rechtin 20 Aug. 1963 16 p
(NASA Contract NAS7-100)
(NASA CR-53047; JPL-TR-32-501) OTS: $1.60 ph, $0.80 mf

Real-time television is possible in either direction—that is, from Earth to Mars and from Mars to Earth—even at the maximum Earth-Mars distance of 400 million kilometers and by utilizing conventional devices. The principal problem appears to be one of engineering these devices so that they possess adequate long life and reliability to accomplish the mission. An emergency teletype link is capable of direct Earth-Mars communications (bypassing the orbital relay) when the landing party's side of Mars is facing the Earth. Temporary loss of communications will occur at semisynodic periods of approximately 13 months when the planets are in opposition or in conjunction. Author

**N64-14851*** General Electric Co., King of Prussia, Pa. Space Sciences Lab.
**METHOD OF CHARACTERISTIC CONSTANTS AND RETROTHRUST OPTIMALITY IN A GRAVITATIONAL FIELD – NECESSARY AND SUFFICIENT CONDITIONS**
Carlos R. Cavoti N.Y., Am. Inst. of Aeron. and Astron. [1964] 13 p refs Presented at the AIAA Aerospace Sci. Meeting, New York, 20–22 Jan. 1964
(NASA Contract NAS8-11040)
(AIAA Paper 64-50) AIAA: $0.50 members, $1.00 nonmembers

The problem of the optimum retrothrust program in an inverse-square-law force field is examined. Special attention is devoted to the analysis of the properties of the intermediate thrust subarcs, as well as to the existence and admissibility of different subarcs forming the extremals, the sequence of these subarcs, and the determination of corner points. It is shown that for free-time, free-range problems the optimum control may be obtained explicitly and that the intermediate-thrust subarcs may be integrated in closed-form. For the boundary-value problem considered here, a sufficiency proof in the class of all extremal arcs which contain the least admissible number of subarcs is developed (restricted sufficiency). This is accomplished by applying the method of characteristic constants. Author

**N64-14867*** National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
**LUNAR MISSION VELOCITY REQUIREMENTS FOR NUCLEAR VEHICLES**
D. R. Saxton and R. J. Harris 2 Apr. 1962 18 p refs
(NASA TM X-51409; M-P&VE-FN-62-DRS-7) OTS: $1.60 ph, $0.80 mf

Data are presented on: (1) the impulsive velocity requirements for injection into the lunar-transfer trajectory and the arrival velocity at periselenum for various transfer times and injection altitudes; (2) the total characteristic velocity required for injection from a 100-nmi circular orbit, with a specific impulse of 765 seconds for transfer time increments of 5 hours, and a wide range of thrust-to-weight ratio; (3) the effect of initial-orbit altitude on the total characteristic velocity required for escape transfers; (4) the effect of specific impulse on the total characteristic velocity required to escape from the 100-nmi orbit; and (5) the total characteristic velocity required to ascend from the lunar surface to the 80-km orbit. I.v.L.

**N64-14885** Defense Research Board, Ottawa (Canada)
**BIBLIOGRAPHY OF DRB SPACE RESEARCH PUBLICATIONS (TO JUNE 1963)**
R. J. Penner, comp. Nov. 1963 26 p refs
(DSIS-B12)

This bibliography contains an annotated list of published papers and reports dealing with space technology. It was prepared by DRB directorates, establishments, grantees, and cooperating agencies. The annotations are taken from catalog cards of the Directorate of Scientific Information Services (DSIS), and consist of author abstracts where available, or of indicative abstracts prepared by DSIS. I.v.L.

**N64-14892*** General Dynamics/Astronautics, San Diego, Calif.
**PARAMETRIC MISSION ANALYSIS**
K. A. Ehricke 30 Aug. 1963 53 p
(NASA CR-55408; AOK-63-024) OTS: $5.60 ph, $1.79 mf

This report represents a preliminary publication of the parametric mission analysis work performed simultaneously in

partial fulfillment of study obligations for Post-Nova III, EMPIRE Follow-On, and the Planetary Transportation Model Studies. I.v.L.

**N64-14893*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

**EARTH-VENUS TRAJECTORIES, 1970, VOLUME 5, PART B**

V. C. Clarke, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer 1 Oct. 1963 792 p refs

(NASA Contract NAS7-100)

(NASA CR-53050; JPL-TM-33-99, Vol. 5, Pt. B.) OTS: $31.00 ph, $23.96 mf

This report presents the results of extensive machine computations of three-dimensional ballistic interplanetary (Earth–Venus) trajectories. The analytical model used to represent these trajectories is based upon two-body, inverse-square, force-field mechanics. Basically, the trajectories are calculated in two distinct parts: (1) the heliocentric transfer ellipse; and (2) the launch-planet-centered escape trajectories. Also, the differential corrections or error coefficients and guidance and tracking parameters are given. I.v.L.

**N64-14929*** Geophysics Corp. of America, Bedford, Mass.

**THEORETICAL ESTIMATES OF THE AVERAGE SURFACE AND ATMOSPHERIC TEMPERATURES ON MARS**

George Ohring 1962 24 p Repr. from Mem. soc. roy. sci. Liege, ser. 5, v. 7, 1962 Presented at the Intern. Colloq., Liege, 9–11 Jul. 1962 p 425–447

(NASA Contract NASw-704)

From theoretical computations based upon radiative equilibrium considerations, the average surface temperature of the planet Mars is found to be in the range of 219° to 233° K. This is in reasonable agreement with the thermal emission observations which suggest a mean temperature of about 233° K. The computations also indicate that the maximum greenhouse effect on Mars is about 40% of the average greenhouse effect in the earth's atmosphere, and that carbon dioxide is the most important contributor to the Martian greenhouse. The major characteristics of the computed vertical distribution of temperature in the Martian atmosphere are an adiabatic troposphere extending to 9 km, and a stratosphere that is stable, but with temperature still decreasing with height. If ozone is present in the atmosphere, additional computations should be made to evaluate its effect on the temperature distribution. Author

**N64-14930*** National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.

**THERMIONIC SCREENING OF BODIES IN THE ATMOSPHERE AND INTERPLANETARY SPACE**

C. S. Shen and K. P. Chopra (Polytechnic Inst. of Brooklyn) Repr. from J. of Atmospheric Sci., v. 20, no. 5, Sep. 1963 p 359–365 refs (Previously published as NASA TM X-50226; see N63-20178 20-13)

(NASA-RP-124)

This paper considers problems that accompany thermionic emission of electrons from a hot body surrounded by a plasma. In the absence of other mechanisms, an electric potential is established at the surface of the body through the balance of thermionic emission and accretion of electrons from the external plasma. Analytical solutions are obtained for the electric potential field and the electron density distribution around the body. A possible application of this analysis to objects in space is indicated. Author

**N64-14981*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**CHARACTERISTICS OF A LUNAR LANDING CONFIGURATION HAVING VARIOUS MULTIPLE-LEG LANDING-GEAR ARRANGEMENTS**

Ulysse J. Blanchard Washington, NASA, Jan. 1964 46 p refs (NASA TN D-2027) OTS: $1.25

An experimental investigation has been made of some lunar-landing characteristics of a 1/6-scale dynamic model of a landing module having multiple-leg landing-gear systems. Symmetric four-point and five-point systems and an asymmetric four-point system were investigated. The landing-gear legs were inverted tripod arrangements having a telescoping main strut which incorporated a yielding-metal strap for energy dissipation, hinged V-struts, and circular pads. The landing tests were made by launching a free model onto an impenetrable hard surface (concrete) and onto a powdered-pumice overlay of various depths. Landing motion and acceleration data were obtained for a range of touchdown speeds, touchdown attitudes, and landing-surface conditions. Author

**N64-14993** Naval Reserve Research Company 12-5, Berkeley, Calif.

**RESEARCH RESERVE SPACE SCIENCE SEMINAR: SUMMARY OF PRESENTATIONS, SAN FRANCISCO, 20 OCTOBER-2 NOVEMBER 1963**

John T. Hayward et al [1963] 31 p refs Summaries Only (Sponsored by ONR)

(AD-429096) OTS: $3.60

Topics discussed during this seminar include astronomy and astrophysics; space exploration; exobiology; spacecraft; propulsion and propellants; entry and landing; space physiology; closed ecological systems; unmanned deep space probes; and space telemetry, communications, and tracking. E.W.

**N64-14996** Joint Publications Research Service, Washington, D.C.

**SECOND SERIES OF GROUND TESTS WITH WEIGHTLESS LIQUIDS**

V. V. Shuleykin 17 Feb. 1964 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 6, 21 Dec. 1963 p 1299–1302

(JPRS 23259; OTS-64-21578) OTS: $0.50

Ground tests, employing a teflon cuvette, were conducted on pure mercury. Results are summarized as follows, with the two figures quoted referring to separate tests: The amount of mercury taken was 140 g and 118 g. A "flat top" with a diameter of 55 mm and 46 mm assumed, at the first stage following the appearance of weightlessness, the form of a toroid growing rapidly at the expense of diameter, and, finally, closing of the ring took place (conversion into a truncated sphere of 33-mm and 31-mm diameter). A sharp peak is generated over the sphere. This peak rises upward with an initial velocity of more than 80 and 75 $cm/sec^{-1}$, and following behind it, ever-new masses of mercury are drawn upward. There is a marked change in the form of the basic body of rotation, which achieves its maximal rise over the floor of the cuvette at 76 mm and 64 mm. Pressure gradients appear that give rise to motion of the mercury at the time of succeeding phases of oscillation, predominantly in the direction from both ends of the body of rotation toward the center of mass. As a result, the entire mass of mercury rises into the air. Also, similar tests with distilled water are discussed. I.v.L.

# 30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

**N64-14274*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**A BIBLIOGRAPHY OF THE SATURN SYSTEM**
Truman E. Mc Clard 12 Dec. 1962 116 p refs
(NASA TM X-50409; M-SAT-62-4) OTS: $9.60 ph, $3.68 mf

To aid those interested in the Saturn development, a partial listing of the documentation has been assembled. The reports are arranged in three principal categories—Technical Reports, Test Reports, and General Documents—and are listed by date of publication. An author index is included. E.W.

**N64-14392*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**AN AERODYNAMIC ANALYSIS OF SATURN I BLOCK I FLIGHT TEST VEHICLES**
Fernando S. Garcia Washington, NASA Feb. 1964 64 p refs
(NASA TN D-2002) OTS: $1.75

The evaluation of telemetered data included axial force calculations, stability analysis, and environmental steady-state and fluctuating pressure data analyses. Comparisons are made with wind-tunnel and/or theoretical, predicted values. Author

**N64-14492** Lockheed Aircraft Corp., Sunnyvale, Calif. Missiles and Space Div.
**RADIATION PLUME GEOMETRY OF MISSILES: AN ANNOTATED BIBLIOGRAPHY**
Charles G. Gros, comp. May 1963 42 p 76 refs
(Contract AF 04(647)-787)
(Rept. 8-19-63-6; SB-63-29; AD-427252)

This work refers to reports on the spectral distribution of radiant energy from the exhaust plumes of intermediate and intercontinental missiles. It also contains references to infrared bibliographies and to such related materials as bears on the location of missile trajectories. Generally, the period covered is for 1961 and 1962. Author

**N64-14555*** National Aeronautics and Space Administration, Washington, D.C.
**THE NASA AEROSPACE NUCLEAR SAFETY PHILOSOPHY**
H. B. Finger *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 33-37 (See N64-14551 06-01) OTS: $4.50

The main point in the philosophy of nuclear safety in the aerospace systems, when human life is involved, is that the system be as reliable as possible; its operation must be assured. The need for an interagency safety review is also discussed. R.T.K.

**N64-14563*** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
**SAFETY OF RIFT VEHICLE LAUNCH AND FLIGHT OPERATIONS**
R. C. Hock (Air Force) *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 131-143 (See N64-14551 06-01) OTS: $4.50

The Reactor-In-Flight-Test (RIFT) vehicle, typical RIFT trajectories, prelaunch, launch, and flight operations, and their related safety considerations based on current planning are described. Current data and analyses lead to the conclusion that the probability of a nuclear incident of any kind as a result of planned RIFT operations at Cape Kennedy is remote. R.T.K.

**N64-14571** Nuclear Utility Services, Inc., Washington, D.C.
**ENVIRONMENTAL SAFETY ASPECTS OF ROCKET FLIGHT OPERATIONS**
M. I. Goldman and C. R. Mc Cullough *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 231-240 refs (See N64-14551 06-01) OTS: $4.50

A description is given by "precision guesswork" of the significant routes of radiation exposure that could occur with a nuclear rocket system that is unprotected by safety systems and of the effect of environmental parameters on the resulting doses. Launch-site hazards and down-range environment hazards are discussed. R.T.K.

**N64-14575** Sandia Corp., Albuquerque, N.Mex.
**AEROSPACE NUCLEAR SAFETY RE-ENTRY FLIGHT TEST PROGRAM**
A. J. Clark, Jr. *In its* Aerospace Nucl. Safety Jan. 1964 p 279-293 (See N64-14551 06-01) OTS: $4.50

The overall flight-test program is presented in chart form. Flight testing embraces three areas of endeavor—reentry system design and development, flight-test launch and range operations, and flight-test data analysis. Launching of the first flight-test system, which is referred to as reentry Flight Demonstration No. 1 (RFD-1), was conducted on a Scout missile. The SNAP 10-A reactor was selected for the first reentry flight demonstration, since it is currently scheduled to be the first reactor-type nuclear auxiliary power supply for space application. The RFD-1 investigated pertinent aspects of the proposed reentry burnup of the reactor to determine the effectiveness of this method for core disposal. Results of the investigation are included. R.T.K.

**N64-14577** Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
**RE-ENTRY OF FUELED GRAPHITE PARTICLES**
J. M. Bridges and H. G. Hargrove *In* Sandia Corp. Aerospace Nucl. Safety Jan. 1964 p 329-350 refs (See N64-14551 06-01) OTS: $4.50

The simulated reentry studies performed in this investigation were conducted in a plasma-jet facility. While it was not possible to duplicate the properties that exist as the surface of the reentering object, stagnation, pressure, and enthalpy were simulated. The mass loss rate of the reentering objects was studied. The materials tested were graphite G, a dense grade of structural graphite having a density of 1.92 g/cc, and uranium-fueled graphite; both materials were machined into hemispherical models 1/8, 1/4, and 1/2 inch in diameter. On the basis of the results of this study, equations were determined that were incorporated into a reentry code, WEREC, which was programed for use in an IBM-7094 digital computer. R.T.K.

**N64-14773** Army Missile Command, Huntsville, Ala.
**TRANSPORTATION-VIBRATION TEST OF PERSHING MISSILE SYSTEM TACTICAL SHIPPING AND STORAGE CONTAINERS, PHASE II Final Report**
Ronald G. Eyestone Dec. 1963 51 p
(RT-TR-63-8; AD-428863) OTS: $4.60

Tactical first- and second-stage shipping and storage containers for the Pershing Missile System, with dummy loads, were subjected to the maximum vibration conditions which they may experience during truck transportation. The test was performed by transporting the containers, truck mounted, over a rough road course while varying the speed to obtain desired g levels. Author

**N64-14786** General Dynamics/Astronautics, San Diego, Calif.
**SPACE LAUNCH VEHICLE FULL-SCALE DAMPING TESTS**
J. G. Miller 21 Jun. 1963 48 p refs
(Contract AF 04(694)-185)
(GDA-63-0376; AD-429015) OTS: $5.60

The wind study portion of testing showed that the SLV gantry tower is sufficiently stable to be used as a base for forced oscillation of the vehicle and that any measurement of relative motion between vehicle and tower is of vehicle movement only. The structural damping ratio of the first cantilever mode of Atlas Agena 461 and 698 BJ varied between a high of 2.14% and a low of 0.57%, depending upon the axes and the tanking condition. It was not possible to determine a damping factor for all cases by the methods used because of the internal (liquid) movements. In general, the theoretical frequencies were verified to an excellent degree. The experimental damping factors agreed reasonably well with the results of previous tests.

Author

**N64-14894*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

**THRUST-VECTOR CONTROL TEST IN THE JET PROPULSION LABORATORY 20-INCH SUPERSONIC WIND TUNNEL [6-10 MAY 1963]**

Edward A. Nierengarten 18 Nov. 1963 13 p refs

(NASA CR-53039; JPL-WT-20-551) OTS: $1.60 ph, $0.80 mf

The purpose of this test was to obtain the pressure and temperature distribution on a flat plate consisting of 95 plate static-pressure ports and 25 plate thermocouples grouped around an injector in the plate surface. The approximate aerodynamic parameters for the test were Mach No. 2.01, 2.61, 3.26, 3.50, 3.99, and 4.54, with Reynolds No./ft from $0.60 \times 10^6$ to $7.20 \times 10^6$. The test variables and ranges were tunnel stagnation pressures from 6.70 to 54.0 psi, gaseous nitrogen injection pressure from 5.0 to 300.0 psi, liquid nitrogen injection pressure from 40.0 to 150 psi. Pressures and temperatures were obtained for the flat plate only, using one single injector and two single opposed injectors. I.v.L.

**N64-14908** Auburn U., Ala.

**AN ANALYTICAL INVESTIGATION OF SHALLOW ATMOSPHERIC ENTRY Final Report**

Fred W. Martin and Branimir Djordjevic Kirtland AFB, N. Mex., 1964 194 p refs

(Contract AF 29(601)-5113)

(RTD-TDR-63-3098; AD-429040)

Several empirical and approximate analytical solutions are given for shallow ballistic reentry. These solutions include a consideration of ballistic parameters from 100 to 6,000 $lb/ft^2$. The results of the solutions in this report are compared with digital computer results. These comparisons show good agreement with the apparent gross characteristics of shallow-angle, near-orbital velocity reentry. The wall temperature due to aerodynamic heating was calculated for several materials, using digital computer trajectories. In addition, the range deviation due to finite stability characteristics was investigated. The reentry path calculations are based on an analytical model that simulates a rotating oblate earth, and utilizes the 1959 ARDC Atmosphere. Author

**N64-14936** Defense Dept., Washington, D.C. Office of the Secretary of Defense

**UNITED STATES GUIDED MISSILES**

[1963] 64 p

GPO: $0.40

Information is presented on the following: (1) surface-to-surface missiles—Corporal, Sergeant, Redstone, Pershing, Lacrosse, Shillelagh, Lance, TOW, Entac, SS 10 and 11, Subroc, Regulus I, Polaris, Matador, Mace, Jupiter, Thor, Snark, Atlas, MMRBM, Minuteman, and Titan; (2) surface-to-air missiles—Nike-Ajax, Nike-Hercules, Nike-Zeus, Nike-X, Sprint, Hawk, Redeye, Mauler, Typhon, Terrier, Tartar, Talos, and Bomarc; (3) air-to-air missiles—Sidewinder, Sparrow III, Phoenix, GAR 1, GAR 2, GAR 3, GAR 4, and GAR 11; and (4) Bullpup, Shrike, Hound Dog, Skybolt, and Quail. R.T.K.

# 31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

No abstracts in this issue.

# 32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

**N64-14260** American Meteorological Society, Boston, Mass. Meteorological and Geoastrophysical Abstracts

**BIBLIOGRAPHY ON METEOROLOGICAL SATELLITES (1952-1962)**

Elemer Kiss, comp. Washington, Weather Bureau, Apr. 1963 400 p refs

GPO: $1.25

This annotated bibliography contains information on the following subjects: (1) general works—books, reports, bibliographies, etc.; (2) instrument carriers—satellites, space probes, rockets; (3) instruments; (4) observational methods and techniques; (5) parameters—atmospheric structure, composition, radiation; (6) weather observations—clouds, storms, etc.; (7) weather forecasting; and (8) programs and projects. R.T.K.

**N64-14267*** California Inst. of Tech., Pasadena

**SCIENTIFIC RESULTS OF THE MARINER II VOYAGE TO VENUS**

Leverett Davis, Jr. 1963 10 p refs Presented at the COPERS Summer School, Alpbach, Austria, 1 Aug. 1963

(NASA Grant NsG-426)

(NASA CR-55369) OTS: $1.10 ph, $0.80 mf

The Mariner II flight to Venus is discussed in terms of the scientific and engineering data transmitted to earth. The flight of this vehicle was considered to be remarkably successful. A large part of the emphasis concerned engineering, and important technological information was obtained. One of the most important results of the Mariner II experiment was the conclusive demonstration that the solar wind flows out from the sun continuously, essentially as in Parker's model, but with lower density than was formerly thought. C.L.W.

**N64-14288*** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

**SATELLITE SITUATION REPORT, VOLUME 4, NO. 1**

15 Jan. 1964 11 p Data Computed and Compiled by NORAD, and Smithsonian Astrophys. Obs.
(NASA TM X-51398; X-533-63-1) OTS: $1.60 ph, $0.80 mf

This report lists objects in orbit that were launched during 1958 to 1964 inclusive. The following information, when possible, is given: code name, source, exact launch date, nodal period, inclination, apogee, perigee, and transmitting frequency. Also, certain objects are added to the decayed list for 1963. I.v.L.

**N64-14321** Goodyear Aerospace Corp., Akron, Ohio
**DESIGN OF LENS-REFLECTOR ELEMENT FOR PASSIVE COMMUNICATIONS SATELLITE [Final Report, Jul. 1961-Jun. 1963]**
Wright-Patterson AFB, Ohio, Directorate of Defense and Transport Systems Eng., Nov. 1963 44 p refs
(Contract AF 33(616)-8475)
(GER-11159; ASD-TDR-63-781; AD-425800)

It was determined that a diffraction-limited device, with a diameter of 4 wavelengths at the design frequency, was superior to a refracting lens reflector with a diameter of 18 wavelengths at the design frequency, considering incident angles from 0 deg to 45 deg. The interrelation between element design and satellite characteristics was developed, and several types of elements were compared. A 10-in.-dia. piano-ellipsoidal lens and a spherical reflector were selected as optimum design. A lightweight inflatable element of this design was tested. Author

**N64-14478** McGill U., Montreal (Canada)
**PROJECT H A R P - REPORT ON THE FIRST TWELVE FIRINGS AND STATUS AS OF JULY 30, 1963**
Nov. 1963 48 p refs
(Contract DA-20-018-ORD-24562; Contract DA-20-018-AMC-019OR)
(Rept. 63-5; AD-428795) OTS: $4.60

The current range status and the results of test firings are described for a program of research and development into the capabilities of vertically fired gun probes. Tests, to date, have confirmed expected gun-launched-probe glide performance. The launcher sabot and vehicle performance has proved quite adequate, with future emphasis being required on both ground and airborne instrumentation (telemetry and ejection systems). C.L.W.

**N64-14702** Philco Corp., Palo Alto, Calif. Western Development Labs.
**COURIER SATELLITE Final Report**
31 Jan. 1963 401 p refs
(Contract DA-36-039-SC-78958)
(WDL-TR1399; AD-403881)

The following areas are discussed: (1) overall operation of the satellite system; (2) physical design development; (3) satellite equipment development; (4) environmental testing; (5) ground support equipment; (6) satellite system integration; (7) reliability; (8) conclusions and recommendations. Author

**N64-14744*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**SPACE FLIGHT OPERATIONS PLAN RANGER 6**
P. J. Rygh, comp. 3 Sep. 1963 178 p
(NASA CR-53038; EPD-78, Rev. 1) OTS: $12.50 ph, $5.54 mf

This space operations plan covers the requirements for the Ranger Block III mission. Operational facilities and support equipment are described, and the flow of data between facilities is outlined to show the operations scheduled to complete the mission. Required instructions and procedures are specified for operating sequences, orbit determination, and disposition of data received. I.v.L.

**N64-14745*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
**SPACE FLIGHT OPERATIONS PLAN RANGER 6**
R. B. Rung, comp. 9 Dec. 1963 187 p (For abstract See N64-14744 06-32)
(NASA CR-53036; EPD-78, Rev. 2) OTS: $13.00 ph, $5.81 mf

**N64-14889*** National Aeronautics and Space Administration, Washington, D.C.
**TIROS, THE FIRST WEATHER SATELLITE**
[1963] 9 p
GPO: $0.10

This paper describes the TIROS meteorological satellite and discusses its missions. TIROS is a weather satellite weighing nearly 300 pounds. It contains two independent television camera systems for observing the earth's cloud cover. Both cameras have half-inch vidicon tubes, which store photographs temporarily. These photographs are converted into TV-type signals by an electron beam and are sent directly to a ground station or are recorded on a tiny tape recorder for readout. TIROS has been used to identify cloud patterns; to locate hurricanes, typhoons, and large tropical storms; for ice surveys; and to obtain information for the study of the radiation balance in the earth's atmosphere. Several photographs that were taken by TIROS are also given. C.L.W.

# 33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

**N64-14256** Joint Publications Research Service, Washington, D.C.
**BEHAVIOR OF SHEET METALS UNDER BIAXIAL STRESS**
Ya. B. Fridman et al 4 Feb. 1964 25 p refs Transl. into ENGLISH of an article from Issled. Splavov Tsvetn. Metal. Akad. Nauk SSSR, Inst. Met. (Moscow), 1963 p 185-203
(JPRS-23055; OTS-64-21472) OTS: $0.75

An approximate analysis of the resistance of sheet metal to plastic deformation is presented. A description of the methods used, and the results of testing of samples (with different original reserves of elastic energy) under biaxial stress are reported. R.T.K.

**N64-14360** Army Missile Command, Huntsville, Ala.
**ON THE STABILITY OF RECTANGULAR PLATES REINFORCED BY STIFFENERS AND SUBJECTED TO BENDING AND SHEAR**
Miodrag Milosavljevitch 25 Oct. 1963 26 p refs Transl. into ENGLISH from Intern. Assoc. of Bridge and Structural Engr., v. 8, 1947 p 141-160
(RSIC-86; AD-426808)

The author deals with the problem of the elastic stability of thin rectangular plates reinforced with horizontal and vertical stiffeners and stressed simultaneously in compound

bending and shear. The investigation is based on the differential equation of the elastic surface. In this way, a general solution with respect both to shape and stresses has been obtained. By way of example two special cases are examined: a plate with a practical form of reinforcement subjected to pure bending and a similar plate subjected to bending and shear. Values of the critical stresses are tabulated as a function of the stiffness of the stiffeners. Author

**N64-14445** Aeronautical Research Labs., Melbourne (Australia)
**EXAMINATION OF A CONSTANT STRESS CANTILEVER**
D. D. Mc Conville and I. G. Scott Jun. 1963 24 p refs
(ARL/SM-281)

An experimental study was made of a constant stress cantilever in order to locate areas of approximately constant strain. Results indicate that if the gages are attached in the prescribed area and located with reasonable care, the cantilever is suitable for calibration purposes. The area of constant strain for the specimens examined appeared to extend from about 3 in. to 8 in. from the root of the cantilever. R.T.K.

**N64-14457** General Dynamics/Astronautics, San Diego, Calif.
**ON NONLINEAR BENDING OF A PLATE STRIP**
Paul E. Wilson 1 Nov. 1963 38 p refs
(GD/A 63-0769; ERR-AN-314)

Ends of an initially straight plate strip are rotated 90°. Using nonlinear bending theory, the maximum stress is obtained as a function of the half-distance between the rotated ends of the strip. Numerical results are presented in nondimensional form. The theoretical solution compares favorably with experimental results. Author

**N64-14462** Royal Aircraft Establishment, Farnborough (Gt. Brit.)
**ON THE LARGE DEFLECTION OF A RECTANGULAR CYLINDRICAL PANEL [O BOL'SHIKH PROGIBAKH PRYAMOUGOL'NOI TSILINDRICHESKOL PANELI]**
K. Z. Galimov London, Min. of Aviation, Nov. 1963 32 p refs Transl. into ENGLISH from Inzhenernyi Sbornik (Moscow), v. 25, 1959 p 20–36
(RAE-TRANS-1051)

An analysis is given of the large deflection of a rectangular cylindrical panel under uniform external pressure with the following boundary conditions: edges simply supported and free to slide in the tangent plane; edges prevented from moving tangentially and either all hinged or all clamped. Author

**N64-14468** Minnesota U., Minneapolis
**CREEP-FATIGUE INTERACTING UNDER CYCLIC LOADING CONDITIONS Technical Documentary Report, Jan.–Apr. 1963**
B. J. Lazan Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1963 52 p refs
(Contract AF 33(657)-7453)
(ASD-TDR-63-644; AD-425551)

The limitations imposed by synergistic or interaction phenomena on the validity of linear superposition and summation approaches are discussed. In particular, single-variable data are shown to be generally inadequate for predicting mechanical properties under combined loads and environments. The immensity of a testing program required to investigate all important combinations of load and environment is illustrated, and the significant reductions possible if synergisms are known are demonstrated. The operative micromechanisms and synergisms under combined static and fatigue loading are discussed, with particular reference to microstructural changes of mechanical and chemical origin. Analytical methods for predicting creep and rupture under variable stress from static creep data are reviewed and compared with experimental results. Author

**N64-14539** Bettis Atomic Power Lab., Pittsburgh, Pa.
**SEAL-SHELL-2 – A COMPUTER PROGRAM FOR THE STRESS ANALYSIS OF A THICK SHELL OF REVOLUTION WITH AXISYMMETRIC PRESSURES, TEMPERATURES, AND DISTRIBUTED LOADS**
C. M. Friedrich Dec. 1963 66 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-398) OTS: $1.50

Seal-Shell-2, an ALTAC-3 computer program in FORTRAN-2 language for a 32,000-word machine, determines stresses and deflections in a thick or thin shell of revolution. The shell is linear-elastic with tensile, bending, and shear strains. Pressures, temperatures, and distributed loads are axisymmetric. In the Seal-Shell-2 program, an arbitrary set of 11 deformation shapes are applied to each segment, and the resulting strain energy is determined under restrictions. By application of the principle of virtual work, the strain energy of each segment (the forces on each segment) is determined in terms of the deflections. Then the simultaneous equations are solved to give the influence coefficients for deflections in terms of forces. The middle surface slope and deflection at all joints of adjacent segments are equated in order to calculate the forces connecting all the segments. Once the forces and deflections are known for each segment, the strain energy relationships already derived give the local stresses and strains. R.T.K.

**N64-14540** Atomics International, Canoga Park, Calif.
**PHOTOELASTIC DETERMINATION OF STRESSES IN THE AI STEAM GENERATOR**
M. M. Levin and M. M. Lemcoe 30 Jan. 1964 55 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8515) OTS: $1.00

The tangential ligament stresses on the surface of the penetrations have two peak tensile values: one near the trepanned top surface, and the other near the bottom spherical surface. In between these two planes, the principal stress $\sigma_1$ is a somewhat smaller, almost constant, tension indicating almost complete membrane stress. The maximum upper peak was found to be 3.9 p, and the maximum lower peak was 4.8 p, which was the maximum stress found anywhere in the steam generator. The maximum stress of 4.8 p occurs on the penetrations that have been rounded at the spherical surface. For the sharp cornered penetrations, a maximum peak stress of only 4.1 p was obtained. On the outer surface of the steam generator, a maximum tensile stress of 3.5 p was found at the fillets between standpipes 1 and 2. Principal stress distributions along a number of other key sections and points are presented in tabular and graphical form. Author

**N64-14550** General Dynamics/Astronautics, San Diego, Calif.
**ON NONLINEAR PRESSURE COUPLING IN CYLINDRICAL SHELL ANALYSIS**
Paul E. Wilson and Edward E. Spier 1 Nov. 1963 15 p refs
(GD/A 63-0767; ERR-AN-316)

Two well-known thin shell theories are used to evaluate and compare shears and moments at the juncture of two pressurized cylindrical shells. For highly pressurized cylinders with large radius-thickness ratios, the numerical results indicate that nonlinear coupling effects of pressure significantly influence computed values of discontinuity shears and moments. Author

**N64-14609** Lockheed Aircraft Corp., Sunnyvale, Calif. Missiles and Space Div.
**A SYSTEMATIC ANALYSIS FOR SHELLS OF REVOLUTION WITH NONSYMMETRIC LOADS**
C. R. Steele Jun. 1962 33 p refs
(LMSC-6-90-61-58)

The solutions, including the particular solutions for surface loads and temperature effects, the deformations for the membrane solutions, and the curvature changes for the inextensional deformation, are presented in what may be their simplest form for the shell of arbitrary meridian. The relative order of magnitude of the contribution of each solution to the various stresses and displacements is tabulated. This tabulation makes apparent the relative magnitudes of the arbitrary constants required to satisfy a particular set of boundary conditions. Then the equations for the constants may be significantly uncoupled or, as for stress boundary conditions, replaced by a simple energy approach. Also, the correspondence between the type of boundary conditions and the nature of the stress in the shell interior becomes evident. Generally, force boundary conditions produce inextensional bending stresses in the interior, while displacement conditions and certain mixed conditions will produce membrane interior stress.
Author

**N64-14624** System Research Ltd., Richmond, (Gt. Brit.)
**A STUDY OF GROUP DECISION MAKING AND COMMUNICATION PATTERNS UNDER CONDITIONS OF STRESS AND OVERLOAD, WHEN THE PARTICIPANTS ARE PERMITTED TO FUNCTION AS A SELF-ORGANISING SYSTEM Quarterly Technical Status Report No. 3, 1 Jul. 1963-30 Sep. 1963**
26 Nov. 1963 9 p refs
(Contract DA-91-591-EUC-2753)
(AD-428615) OTS: $1.10

Pictures and functional descriptions are presented for the display and control panels for the adaptively controlled groups.
J.E.T

**N64-14674** Aberdeen Proving Ground, Md. Ballistic Research Labs.
**THE ELASTIC RESPONSE OF THIN SPHERICAL SHELLS TO INTERNAL BLAST FROM ECCENTRICALLY PLACED EXPLOSIVE CHARGES**
Wilfred E. Baker Nov. 1963 33 p refs
(BRL-Memo-1520; AD-428286)

This report presents a theory of elastic response of a thin spherical shell to the axisymmetric blast loading obtained by detonation of eccentrically placed explosive charges within the shell. Some measurements of response of a small steel shell are also reported. No comparison is made between theory and experiment, because of difficulties encountered in computation from the theory.
Author

**N64-14720** Oak Ridge National Lab., Tenn.
**PRESTRESSING A TWO-LAYER PRESSURE VESSEL BY CONTROLLED YIELDING OF THE INNER LAYER**
R. W. Schneider 29 Jan. 1964 32 p refs
(Contract W-7405-eng-26)
(ORNL-3546) OTS: $0.75

This paper presents a method of designing a two-layer pressure vessel wherein contact between the layers is produced by controlled yielding of the inner vessel by internal pressure. The amount of prestress depends upon the dimensions of the vessel, the properties of the material of construction, and the prestessing pressure. The method takes into account the actual stress–strain curve of the material and satisfies the rules of plastic flow with work hardening.
Author

**N64-14968** Pennsylvania State U., University Park Ordnance Research Lab.
**SOLID GLASS AND CERAMIC EXTERNAL-PRESSURE VESSELS**
J. D. Stachiw 15 Jan. 1964 80 p
(Contract NOw-63-0209-c)
(AD-428905)

Solid glass or ceramic hulls provide the maximum buoyancy and internal useful volume for underwater vehicles. This material displays low-creep characteristics and withstands external-pressure cycling and mild underwater dynamic pressures. Scratches on the exterior surfaces do not decrease appreciably the compressive and elastic strength of such vessels when exposed to either static or cycling pressure. Connectors have been devised that enable glass cylinders to be joined into a monolithic structure that is resistant to both pressure and flexure.
Author

**N64-14987*** Michigan U., Ann Arbor, Mich.
**FREQUENCIES AND MODES OF VIBRATION OF BUCKLED CIRCULAR PLATES**
B. Herzog and E. F. Masur Washington, NASA, Feb. 1964 33 p refs
(NASA Grant NsG-132-61)
(NASA TN D-2245) OTS: $1.00

When subjected to sufficiently large radial pressure, a circular plate buckles into a configuration that is governed by a set of nonlinear equations. The present note considers the frequencies and modes of vibration of small amplitude about this configuration. Perturbation techniques are employed near the buckling point; as buckling proceeds solutions are obtained through power series expansions. Although the static buckling configuration is radially symmetric, no such restriction is imposed on the modes of vibration. The analysis is exact within the limits of classical plate theory and in the sense of a converging series that has been truncated.
Author

**N64-14994** Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.
**EFFECT OF CONSTANT LONGITUDINAL ACCELERATION ON THE TRANSVERSE VIBRATION OF UNIFORM BEAMS**
Paul Seide 21 Oct. 1963 32 p refs
(Contract AF 04(695)-169)
(TDR-169(3560-30)TN-6; SSD-TDR-63-244)

The effect of longitudinal inertia forces on the natural transverse vibration frequencies of a beam given a constant acceleration by a force applied at one end is investigated. The variation of the frequency spectrum with end load is presented in both tabular and graphical form. The variation of modal patterns with end load is also shown.
Author

# 34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

**N64-14314** Picatinny Arsenal, Dover, N.J.
**FILAMENT WINDING IN MILITARY APPLICATIONS: A DISCUSSION OF PROBLEMS ASSOCIATED WITH FILAMENT WOUND MOTOR CASES**

Allen M. Shibley Sep. 1963 40 p refs Presented at Symp. on Design Criteria for Plastics, Stevens Inst. of Tech., Hoboken, N.J., 11–13 Sep. 1963
(Plastec Note 8; AD-425147) OTS: $1.00

Design of filament-wound structures is discussed in relation to material selection, winding technique, quality control, process control, and test methods. The design is illustrated by specific example of a rocket-motor chamber. Buckling, which has become more critical with higher-strength lighter-weight chambers, is analyzed together with other important engineering properties of the glass-filament-reinforced composite. Author

**N64-14640** Republic Aviation Corp., Farmingdale, N.Y.
**EVALUATION OF HIGH-STRENGTH LIGHTWEIGHT LAMINATED PRESSURE VESSELS OF LAP-JOINT CONSTRUCTION Final Summary Report, 1 Dec. 1961–30 Sep. 1963**
G. Citrin 30 Oct. 1963 112 p
(Contract DA-30-069-ORD-3440)
(WAL-TR-766.2/3-5; AD-427344)

Ten vessels have been fabricated and tested to failure. They were fabricated of three nominal thicknesses of material—0.025-, 0.040-, and 0.064-in.-thick maraging steel. The vessels are approximately 2 ft in diameter and range from 3 1/2 to 6 ft in length. An analysis of the results of these tests indicates it is feasible for lightweight, laminated pressure vessels of lap-joint design to be considered for application to rocket-motor-case construction. Author

**N64-14862*** Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
**INVESTIGATION OF STRUCTURAL PROPERTIES OF FIBER GLASS FILAMENT-WOUND PRESSURE VESSELS AT CRYOGENIC TEMPERATURES Quarterly Progress Report No. 2 [1 Oct.–31 Dec. 1963]**
J. M. Toth, Jr. Jan. 1964 98 p refs
(NASA Contract NAS3-2562)
(NASA CR-55410; SM-45810) OTS: $8.60 ph, $3.14 mf

The following tasks were completed: (1) Fabrication of required 7-1/2-in.-diam. biaxial specimens was completed. (2) Preliminary analysis and design of the 18-in.-diam. pressure vessel were completed. (3) Preliminary tooling design and fabrication for the 18-in.-diam. pressure vessel were completed. (4) A successful liquid-hydrogen burst test was made with an electrodeposited nickel lined 7-1/2-in.-diam. biaxial specimen. (5) Liquid-hydrogen biaxial cyclic tests were initiated. Author

**N64-14923** Hanford Atomic Products Operation, Richland, Wash.
**DOME SEAL PERFORMANCE TESTS**
D. H. White Nov. 1963 39 p refs
(Contract AT(45-1)-1350)
(HW-79205) OTS: $1.00

A high-temperature, high-pressure, self-tightening, metal-to-metal nozzle closure known as a Dome Seal was tested and found to be unusually leak tight in a high-temperature water environment. The dome seal appears to have considerable promise for nuclear reactor application and many other applications where zero leakage at high pressure and/or high temperature is required. Author

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